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Vol. 2 FEBRUARY, 1921 No. 1

RESEMBLANCES AND CONTRASTS BETWEEN ZOOLOGIC AND PALÆONTOLOGIC RESEARCH IN MAMMALOGY. DESIRABILITY OF UNIFORM STANDARDS AND SYSTEMS IN CLASSIFICATION, IN DESCRIPTION, IN MEASUREMENT, IN REASONING[1]

By Henry Fairfield Osborn

In submitting this paper the author presented a model of the skull of *Eotitanops gregoryi*, the diminutive Eocene ancestor of all the titanotheres; a fossil skull of *Palæosyops major*, an extremely short-headed titanothere; a fossil skull of *Dolichorhinus hyognathus*, an extremely long-headed titanothere; also, for comparison, recent skulls of a broad-headed bulldog and of a long-headed greyhound. He further submitted recent papers by several leading mammalogists, namely, Messrs. Allen,[2] Merriam,[3] Osgood,[4] and his own memoirs on the "Systematic Revision of the Equidæ"[5] and the "Craniometry of the Equidæ,"[6] as examples of resemblances and contrasts in palæontologic and zoologic methods.

[1] Paper presented by the author, under this title, at the meeting of the Society, May 3, 1920, in the American Museum of Natural History.

[2] Allen, J. A. Ontogenetic and Other Variations in Muskoxen, with a Systematic Review of the Muskox Group, Recent and Extinct. Mem. Amer. Mus. Nat. Hist., N. S. vol. I, part IV, March, 1913.

[3] Merriam, C. Hart. Review of the Grizzly and Big Brown Bears of North America. North American Fauna, no. 41, February 9, 1918.

[4] Osgood, Wilfred H. Revision of the Mice of the American Genus *Peromyscus*. North American Fauna, no. 28, April 17, 1909.

[5] Osborn, H. F. Equidæ of the Oligocene, Miocene, and Pliocene of North America, Iconographic Type Revision. Mem. Amer. Mus. Nat. Hist., N. S. vol. II, part 1, May, 1918.

[6] Osborn, H. F. Craniometry of the Equidæ. Mem. Amer. Mus. Nat. Hist., N. S. vol. I, part 3, June, 1912.

Mammalogy began as the science of mammalian life, of the structure of mammals as well as of their habits, of their classification based on existing life, of the changes shown in geographic distribution (Buffon). The founders of this science, Linnæus and Buffon, naturally paid greater attention to external characters, to obvious osteological and dental characters, than to some of the internal characters. Buffon was impressed with the geographic variation of mammals. The older classification up to the time of Owen was based partly upon habits of feeding (e.g., Insectivora, Carnivora), and partly on external characters (e.g., Pachydermata). With Cuvier,[7] deBlainville,[8] and Owen[9] began the more intensive study of the osteology and odontography of the mammals, together with the foundations of mammalian palæontology as developed in the master hands of Cuvier and of Owen. Flower paid closer attention to the osteology of the mammals and did little to develop the odontography.

In the time of Darwin the subject divided into (a) the zoology and (b) the palæontology of the mammals. This division has gradually led to different principles and methods of research based on the different nature of the materials, such as the absence of all soft parts, and the fragmentary nature of the hard parts in fossil mammals. An intensified and philosophic study of the hard parts became essential to progress.

The more recent tendency among palæontologists is to bring these two branches together again (Lydekker, Scott, Wortman, Osborn, Matthew, Gregory, Gidley, Miller, and others). The first in this country to study the zoology of mammals on Darwinian principles, i.e., geographic and ontogenetic variation in color and form, was Allen (1876).[10] The older school of vertebrate palæontologists of this country, Leidy, Cope, and Marsh, worked almost exclusively on the osteology of the extinct mammals, but in his later years Cope developed the odontography by founding the tritubercular theory. He also

[7] Cuvier, Georges L. C. F. D. Recherches sur les Ossemens Fossiles de Quadrupèdes. Tomes I–IV, 1812.

[8] deBlainville, H. M. Ducrotay. Ostéographie des Mammifères. 1839–1864.

[9] Owen, Richard. Description of Teeth and Portions of Jaws of Two Extinct Quadrupeds (*Hyopotamus vectianus* and *H. bovinus*) . . . . with an attempt to develop Cuvier's idea of the classification of Pachyderms by the number of their toes. Quarterly Journal of Geol. Soc. of London, vol. IV, 1848, pp. 103–141, pls. VII, VIII.

[10] Allen, J. A. The American Bison, Living and Extinct. Mem. Mus. Com. Zool., Harv. Univ., vol. IV, no. 10, 1876.

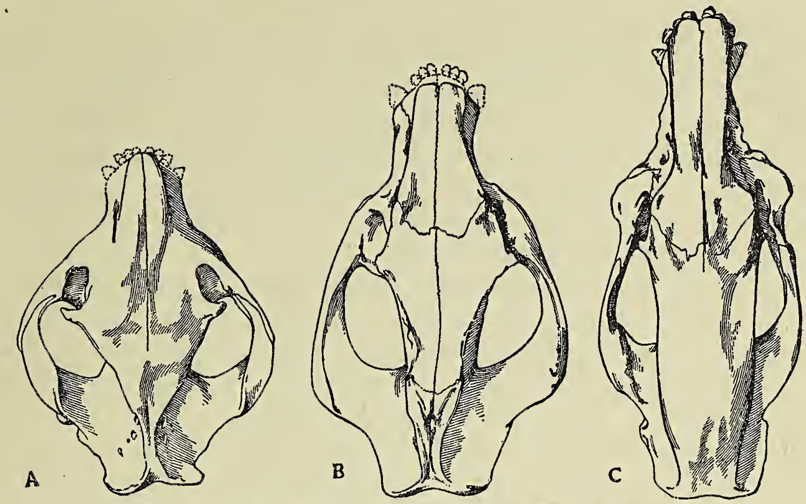

Fig. 1. Skull Proportions Among Titanotheres

A, Brachycephaly, short-headed, *Palæosyops major*. *B*, Mesaticephaly, medium-headed, *Manteoceras manteoceras*. *C*, Dolichocephaly, long-headed, *Dolichorhinus hyognathus*.

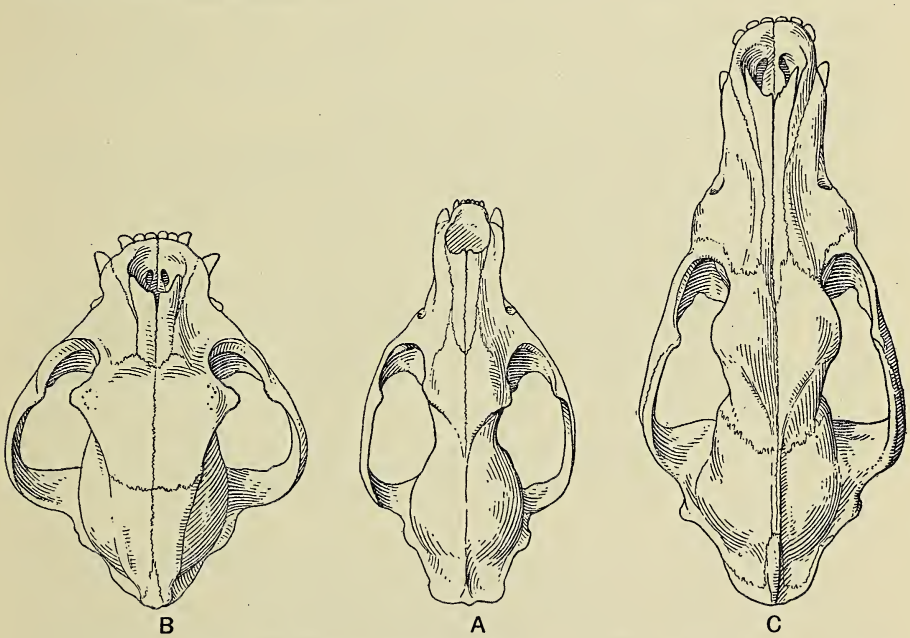

Fig. 2. Skull Proportions Among Canidæ

A, Primitive, subdolichocephalic (*Daphœnus hartshornianus*). *B*, Brachycephalic (bulldog). *C*, Dolichocephalic (Russian wolf-hound).

developed the mechanical interpretation of the bones and of the teeth in relation to function but without close regard to musculature. Marsh and Cope began to observe the phylogeny of the mammals. Marsh came near the truth in the phylogeny of the horse. Independently in Europe Gaudry[11] made great contributions to the phylogeny of the mammals. Kowalevsky (1872)[12] was the first to study the details of tooth and foot structure in relation to the Darwinian principles of adaptation, survival, and extinction.

Of the leading mammalogists of this country Allen followed his earlier observations on the pelage and other external characters by the intensive study of the variations of the skeleton, of the skull, and of the dentition in several groups of mammals, especially the bison and the muskoxen. In the former he took account of extinct forms. The present honored president of this Society, Merriam, has led the way in studying the skull intensively with its modifications in *relation to the function and distribution of the muscles*, in the rodents especially.

Many of the colleagues and junior workers of these two leaders have won distinguished success in the study of the geographic variations of the skull and skeleton, especially Miller, Osgood, Grinnell, and Hollister. One of the most marked evidences of the appreciation of this school of American research is the invitation to Miller by the Trustees of the British Museum to write the "Mammals of Western Europe,"[13] a work now recognized in Europe as a classic.

The younger school of mammalian palæontologists in this country, mostly of the school of Osborn and Scott, have made a distinct advance upon the work of Leidy, Cope, Marsh, Gaudry, and Kowalevsky in the following five directions:

I. Intensive study of the teeth, leading to the use of a new odontography of the Mammalia, based primarily on the tritubercular theory of Cope. This odontography in the hands of Osborn, Scott, Matthew, Gregory, and other colleagues has become the standard odontography of the Mammalia. It was founded upon the original studies of Osborn suggested by the original tritubercular theory of Cope; the homologies have been modified by studies of Gidley and Gregory; the terminology stands.

[11] Gaudry, Albert. Les Enchainements du Monde Animal dans les Temps Géologiques Fossiles Primaires (1883) and Secondaires (1890).

[12] Kowalevsky, W. Sur L'Anchitherium Aurelianense Cuv. et sur L'Histoire Paléontologique des Chevaux. Mem. L'Académie Impériale des Sciences de St. Petérsbourg, VII^{e} Serie, tome XX, no. 5 et dernier.

[13] Miller, Gerrit S. Mammals of Western Europe, 1912. Brit. Mus. Nat. Hist.

II. Intensive study of the evolution of the living and fossil ungulate skull and skeleton and of the teeth by the means of indices (measurements of a single bone or tooth) and of ratios (comparative measurements of two bones or of teeth and bones). This has been especially the work of Osborn and of Gregory on the titanotheres and of Osborn on the horses. In the limbs, Cope (1889)[14] adumbrated this idea. In 1900 Osborn[15] worked out the angulation, which was developed by Gaudry (1906).[16] R. C. Osburn (1906),[17] a student of Osborn, applied the idea in aquatic adaptation. Matthew (1909)[18] took up the limb-ratios of Carnivora in relation to weight and speed.

III. Phylogenetic intergradations of skeletal and tooth form as observed in the finely intergrading ascending and descending geologic stages of evolution. This has been the work of Osborn, Scott, Matthew, Granger, and Gidley in this country, and of Depéret in France.

IV. Application of the principles of mechanics to the muscles and evolution of the proportions of the limbs. This has been chiefly the work of Osborn and of Gregory. Gregory, especially, has developed the mathematical aspect of this subject and the means of restoring the musculature of extinct mammals.[19]

This method has been partly anticipated by the physical anthropologists, also by the leading students of animal motion. This extended investigation by Osborn and Gregory in perissodactyls, compared with amblypods and proboscideans, opens up principles which apply equally to all quadrupeds and bipeds, reptilian, avian, mammalian.

V. Substitution of a vertical phylogenetic or phyletic classification for the horizontal geographic classification of Linnæus, Flower, and Cope. Osborn, especially, has worked out this system of classification

[14] Cope, E. D. The Mechanical Causes of the Development of the Hard Parts of the Mammalia. Journ. of Morphology, vol. III, pp. 137–290, 1889.

[15] Osborn, H. F. The Angulation of the Limbs of Proboscidea, Dinocerata, and Other Quadrupeds, in Adaptation to Weight. Amer. Nat., vol. XXXIV, pp. 89–94, 1900.

[16] Gaudry, Albert. Fossiles de Patagonie. Les Attitudes de quelques Animaux. Ann. de Paleontologie, tome I, pp. 1–42, 1906.

[17] Osburn, R. C. Adaptive Modifications of the Limb Skeleton in Aquatic Reptiles and Mammals. Ann. N. Y. Acad. Sci., vol. XVI, no. 9, part III, pp. 447–482, March 1, 1906.

[18] Matthew, W. D. The Carnivora and Insectivora of the Bridger Basin, Middle Eocene. Mem. Amer. Mus. Nat. Hist., vol. IX, part VI, 1909.

[19] Gregory, W. K. Notes on the Principles of Quadrupedal Locomotion and of the Mechanism of the Limbs in Hoofed Animals. Ann. N. Y. Acad. Sci., vol. XXII, pp. 267–294, 1912.

in the rhinoceroses and horses, as well as in other perissodactyl families and in the proboscideans. This mode of classification has been more or less widely accepted. The most debatable point is the adoption of the special family term ending in *-inæ* for the phylum. For example, the family of rhinoceroses is divided by Osborn into six phyla,[20] each of which is assigned a subfamily name. Similarly Osborn divides the Proboscidea into six phyla,[21] each of which takes a subfamily name. Some of these subfamilies or phyla are shown to be extremely ancient, to go back millions of years, e.g., the long-jawed phyla of the Proboscidea, which goes back to the Lower Oligocene.

In the case of the titanotheres, extending over more than a third of the Tertiary period, the family is subdivided into *twelve* subfamilies or phyla, which are separated by *distinct evolutionary tendencies* leading to different extremes of structure.

In mammalian palæontology Merriam, Lull, Loomis, and Stock have been advancing both the phyletic and zoogeographic methods of research.

In the meantime equally intensive observations have been made by Osgood, Grinnell, Nelson, G. M. Allen, Bailey, Howell, and other mammalogists on two very important principles of mammalogy, namely:

1. Intensive study of the relation of geographic distribution and vertical range on proportional characters of the skull and skeleton, and on the color characters of the pelage.

2. The linking up of distinct geographic forms through geographic connecting intergrades. The special paper to which I allude is the paper by Osgood on *Peromyscus*.

The latest phase of zoologic mammalogy in this country is seen in the work of Sumner[22] in attempting to analyze the variations of *Peromyscus* from the standpoint of the mutation theory of DeVries, of

[20] Osborn, H. F. Phylogeny of the Rhinoceroses of Europe. Rhinoceros Contributions no. 5. Bull. Amer. Mus. Nat. Hist., vol. XIII, art XIX, pp. 229–267, Dec. 11, 1900.

[21] Osborn, H. F. A Long-Jawed Mastodon Skeleton from South Dakota and Phylogeny of the Proboscidea. Bull. Geol. Soc. Amer., vol. 29, no. 1, pp. 133–137, Mar., 1918.

[22] Sumner, F. B.

The Rôle of Isolation in the Formation of a Narrowly Localized Race of Deer-Mice. Amer. Nat., Vol. LI, pp. 173–185, March, 1917.

Genetic Studies of Several Geographic Races of California Deer-Mice. Amer. Nat., Vol. XLIX, pp. 688–701, Nov., 1915.

Continuous and Discontinuous Variations and Their Inheritance in Pero-

Mendelism, and of modern genetics, as well as from the older standpoint of geographic and climatic variation.

One of the newer aspects of field and museum work is the careful notation and emphasis on habit, habitat, and environmental relations, as developed in the Congo collections of the American Museum of Natural History and the publications thereon by Lang and Chapin.

SUMMARY

In the above very imperfect review, which does not pretend to mention all the notable workers nor all the various fields of work, it is seen that there has been a gradual and entirely natural *divergence* between *zoologic* and *palæozoologic* workers in mammalogy. It is obviously desirable to bring these workers together and to select the most consistent and philosophic methods from each. Such a union is now in progress in the joint researches of Gidley (a palæontologist) and Miller (a zoologist) on the phylogeny, evolution, and classification of the Rodentia.

All these observers and natural philosophers are treating exactly the same animal—the mammal—from different points of view. Yet in reading some of their writings and comparing them with my own, I am reminded of the old East Indian fable of the blind men and the elephant. Each of the blind men formed an entirely different opinion of the character of the elephant from the particular part of the animal's anatomy on which his hand rested, namely, trunk, tusk, the limb, the chest, etc.

My desire in the present communication is to point out that these different modes and methods of research which have sprung up independently among zoologists and palæontologists should be harmonized. It is important that zoologists and palæontologists should read each other's papers, speak the same language, and use the same terminology. It is important that they should use similar methods of measurement, similar indices and ratios, similar terms in the nomenclature of the teeth and of the skeleton. I am confident that such harmonic methods will be developed, especially among the younger members of this Society, such as Anthony and Camp, who have been trained both in the school of zoology and of palæontology.

myscus. Amer. Nat., Vol. LII, pp. 177–208; 290–301; 439–454, April–Sept., 1918.

Autonomy of the Tail in Rodents. Biological Bulletin, Vol. XXXIV, pp. 1–6, Jan., 1918.

Several Color "Mutations" in Mice of the Genus Peromyscus. Genetics, vol. 2, pp. 291–300, May, 1917.

PRINCIPLES AND NOMENCLATURE OF PROPORTION CHARACTERS

I have recently pointed out that in mammals the larger percentage of the characters employed in specific and subspecific description are *proportion characters* and *color intensity characters.* The remaining smaller percentage are *new characters* or *presence and absence characters* (see Miller's "Mammals of Western Europe").

As a beginning, we mammalogists might adopt one system of observation and description in the matter of the proportions of the skeleton and of the skull and unify the different modes of description which prevail at present as, for example, in Miller's "Mammals of Western Europe," in Merriam's recent studies of the bears of North America,[23] in researches on limbs and skulls of ungulates of Osborn, and in the craniology introduced by Osborn of the horse and of the titanotheres.

In respect to limb proportion also, recent discoveries by Osborn and Gregory among the ungulates show that the very precise proportions expressed by indices and ratios enable us to divide the ungulates into ambulatory, submediportal, mediportal, and graviportal types, and into cursorial and subcursorial types. These are convergent or homoplastic types quite irrespective of ancestry. For example, a horse and an antelope, capable of carrying the same body weight at the same speed, exhibit exactly similar indices and ratios in their limbs. These similar proportions are adaptations to speed and weight which evolve quite irrespective of family lines.

SIX DIVERSE CAUSES OF VARIATION

Another principle of skeletal proportion also requires reconsideration from the standpoint of the newer biological studies enumerated by Osborn in his recent work, "The Origin and Evolution of Life," in which the close relation of the proportions of various parts of the body to the internal secretions of the endocrine glands is demonstrated. The principal endocrine glands are the interstitial (sex), the thyroid, the thymus, the pituitary, the suprarenal, the pineal; all are now known to influence growth and development. For example, the proportion of the pelvis in the horse has a direct relation to the secretion of the interstitial tissues of the sex glands; a stallion pelvis has different proportions from that of a gelding, as well as from that of a mare.

[23] Merriam, C. H. Review of the Grizzly and Big Brown Bears of North America. North American Fauna, no. 41. 1918.

Consequently, differences which have been classed and lumped together in long tables of measurement hitherto as *variations of proportion* may be now analyzed as partly due to one or more of a great number of different causes, namely:

(1) Proportions due to differences of habit and modes of locomotion.

(2) Proportions due to differences of nutrition, kinds and habits of feeding.

(3) Proportions due to normal differences of sex, male and female.

(4) Proportions due to internal or endocrine secretions, e.g., of the male and female sex glands.

(5) Proportions due to adaptive changes during age and growth correlated with precocity or helplessness in the young, and juvenile, mature, and senescent development of the sex glands.

(6) Proportions due to the withdrawal of the internal secretions after the natural close of the activity of the sex glands.

(7) Proportions due to compensatory growth.

First: it is obvious that older systems of measurements, which lumped all measurements together as "variations," irrespective of cause, lacked such analysis of the *causes of proportion.* Second: it is clear that many of the differences that have been treated as hereditary variations—as material for natural selection—are not variations at all in the true sense of the term, but are really adaptations to seven or more different sets of causes which vary with conditions of life. Third: we have reason to suspect that the mean fluctuating variations of size and proportion may be mere individual and ontogenetic phenomena, nonheritable, and consequently without bearing on racial evolution.

Compensatory changes of proportion are often profoundly important. For example, it has been shown that a dog with the fore limb experimentally removed tends to develop *saltatorial proportions* in the hind limbs, by way of compensation for the loss of the fore limb, that is, to imitate the springing type of limb, e.g., the hare. It follows that ontogenetic changes in hind limb proportion may be brought about through defects in fore limb proportion.

I have reached the opinion that if we could eliminate these seven or more causes of modification and variation, and measure a very large number of similar bones (the pelvis, for example) of animals of (1) the same habits, (2) the same food, (3) the same sex, (4) the same intensity of endocrine secretion, (5) the same age, (6) the same sexual stage, (7) of exactly the same strain or race, there would be a *standard length and breadth.* I believe that nature tends to *standardize every bone in all pure breeds and to eliminate variations in proportions.* Otherwise

we should not observe such uniform powers of rapid locomotion in wild herds of mammals and wild flocks of birds. Consequently a large part of the elaborate *tables of variation* signify little except that there is an *incessant change of proportion in every bone of the body from birth to death*, some of which is adaptive, some accidental or fortuitous, some really hereditary and significant. Nor is there any single part of the skeleton which can be taken as a norm or base by which other parts can be measured. This is not inconsistent with the fact that skeletal *indices* and *ratios* based on animals of the same sex and same age may constitute excellent subspecific and specific characters, and may also be much more reliable in definition than the present descriptive terms "longer," "shorter," "broader," "deeper," etc. As good a definition of a race, of a subspecies, or of a species, as any other, would be a number of its indices and ratios taken from different parts of the skeleton. It appears that direct measurements are profoundly altered by gigantism and dwarfing, but indices and ratios remain the same. Again Allen (1887) has led the way by applying the method of ratios in his discussion of the skeletal characters of *Monachus* in comparison with three other phocids. In his paper on *M. tropicalis*[24] he presented comparative ratios for the skull (pp. 11, 12, with table), skeleton and limb segments (pp. 12–17) with important and suggestive results.

CONCLUSION

In this paper I have pointed out only a few of the many resemblances and contrasts between zoologic and palæontologic research in mammalogy. The palæontologist who does not study living mammals is out of date; the modern palæontologist is constantly studying living mammals to supplement his limited material in tooth and bone and to check his constructive imagination as regards habits and habitat. The zoologist who does not study fossil mammals fails to perceive some of the most fundamental processes of mammalian evolution. For by a strange paradox, which I have pointed out many times, every character in a living mammal appears to be static or in a state of rest,[25]

[24] Allen, J. A. The West Indian Seal (*Monachus tropicalis* Gray). Bull. Amer. Mus. Nat. Hist., vol. II, pp. 1–34, April, 1887.

[25] "Within historical times we have absolutely no evidence of serious evolutionary change. A system that would have sufficed for three thousand years in the past will probably do for an equal time in the future. By the time evolutionary change introduces serious disturbance in the present scheme of things it is probable that our whole classification system will have been scrapped for something better or else altered beyond recognition."—P. A. Taverner: The Test of the Subspecies. Jour. Mamm., vol. I, no. 3, p. 125, May, 1920.

while every character observed in a phylum of extinct mammals is found to be kinetic or in a state of motion.

Palæontology reveals many other paradoxes, unsuspected by zoology. For example, unprotected animals which may be breeding very rapidly and varying widely, like the mice, may be evolving very slowly, while highly protected mammals which are breeding slowly, like the elephants, may be evolving very rapidly. In these and many other animals, as recently pointed out by Conklin, there is an inverse ratio between the law of selection (survival and elimination) and the rate of adaptive evolution. This shows that in Nature evolution is not hastened by rapid breeding and selection, but that rapid evolution may be due to other causes.

American Museum of Natural History, New York City.

A NOTE ON THE HABITS OF THE TIMBER WOLF

By Charles Eugene Johnson

Opportunities for close-up view of the wild timber wolf in action are, I believe, sufficiently rare to justify submitting the following notes.

The summer of 1912 was spent in making some studies and collections of mammals in northern Lake County, Minnesota, in a portion of the Superior National Forest. The evening of September 1, my companion, Harold N. Hanson, and I, traveling by canoe, returned to one of our main camps after a four days' absence in a more remote locality. As we pulled up at our landing place, which was at the upper end of a rapids and about half a mile from our camp, we observed numerous wolf tracks in the mud along the river bank; these had not been there when we left camp a few days before. But it was now after sundown and too late for further investigation.

The next day a strong northwest wind was blowing and at 3:30 in the afternoon, taking a couple of large traps and my rifle, I set out to discover if possible the meaning of the many wolf tracks. Upon approaching the landing place I moved very cautiously, more as a matter of habit than with any expectation of seeing anything unusual. Just before emerging into the open space by the landing I caught the sound of gentle splashing in the water and, peering through a little opening in the bushes, I saw a timber wolf in the river, stationary, but rising and falling as if "treading water" and taking savage bites at a large body

which was afloat but apparently anchored in the stream. For a few moments I stood intently gazing at this unexpected sight before it became clear to me that the animal was feeding upon something. Thereupon, with eyes still fixed upon the wolf I proceeded as cautiously and as speedily as possible to deposit my traps upon the ground, but before I was able to free myself entirely of the encumbrance a slight clank of the metal sounded and, instantly pricking up its ears, the wolf ceased its exertions and started for the shore, swimming towards me, obliquely to my left. This shore for the wolf was not more than about ten feet distant. Hastily but with the utmost confidence I took aim through the swaying leafy branches and fired just as the wolf was about to disappear behind a large boulder at the edge of the water. My next move was to run quickly out upon a drift-log in the only immediately accessible part of the river in order to have the animal in view and to get in another shot if necessary. When I reached the log I saw the wolf standing motionless on the shore, its head and shoulders concealed behind some bushes, facing diagonally away from me. Steadying myself with as much alacrity as the uncertain footing would permit I fired at the exposed body only to see the wolf flinch and disappear in the thick woods, to be seen or heard no more.

Upon my return after an attempt to track the beast I inquired into the failure of my first shot and discovered that the bullet had struck the projecting edge of a rock concealed by the foliage. The wolf when it landed was therefore untouched. Its hesitation on the bank, while it seemed the height of cool nerve and presence of mind, was no doubt due merely to a momentary bewilderment and uncertainty as to the direction in which the danger lay. The noise from the rapids together with the high wind clearly rendered it difficult to tell the direction of the shot as well as of the lesser disturbance caused by myself in rushing out from the bushes and onto the drift-log. The animal was furthermore entirely dependent upon the sense of hearing in this instance, for it seemed certain from all appearances that the wolf had not had even a glimpse of my person during the entire time up to the moment when my second shot was fired, and possibly not then. That it swam to my side of the river instead of retreating to the opposite bank was probably also due to its inability to accurately locate the source of the first disturbance; but on the other hand this shore was the nearer, the other being fully three times as far away. In looking over the situation later I found that at no time had the wolf been more than about forty feet distant from me and that when the first shot was fired it was

approximately twenty-five feet away. Its size indicated a full-grown animal.

The floating object upon which the wolf had been feeding proved to be an adult cow moose, recently dead. It lay in a pool about six or seven feet deep, but a short distance above the swift water of the rapids and was held in place by a long pole lying crosswise in the current. The nearer shore would probably have presented some difficulty in landing for an animal the size of a moose because of a number of large boulders at the edge of the water, while upstream passage was entirely barred by a mass of drift; but the opposite bank offered easy hauling-out places down as far as the turbulent water of the rapids. Whether the moose had accidentally drowned or had died suddenly from some natural cause while in the river to feed is a matter of speculation, and the possibility remains that the cow had been frightened or driven into the river by wolves and had there floundered about until exhausted. In the back, opposite the kidneys, a large deep hole had been eaten into the carcass and it was here the wolf was feeding when surprised. No other part of the moose, so far as could be observed in the difficult situation, bore any signs of attack.

On August 14 of the present year another opportunity presented itself for a near view of a timber wolf in its native haunts, this time with more disastrous termination for the wolf. It was in the same general region of the Forest Reserve but further out, namely on the upper courses of the Isabella River, at what is known as Rice Lake. Accompanied by my wife I was spending a few weeks' vacation in some further observations in that territory, under federal and state permits.

At 10:30 in the forenoon on the date mentioned we were on our way, by canoe, for a day's exploration about the shores of Rice Lake and had stopped to fish for a little while in a favorable spot in the Isabella River, at the entrance into the lake. Below this point the river is flanked on each side by a meadow of grass and low shrubbery extending back at different points from perhaps twenty-five to a hundred or more yards before the timberline proper is reached. While thus quietly engaged we noticed an animal moving along the edge of the river on the east bank, about three hundred yards down stream. A glance through the field glass revealed it as a wolf and it was then moving at a slow trot. We determined to follow it on the chance that an opportunity for a near approach should present itself, for although we were but poorly equipped, our only arm being a little 410-gauge shot-gun, we

had the day before prepared for just such an emergency by loading a couple of shells with two small buck-shot, in addition to the regular "dust shot" they contained which served as "packing." By good fortune I had these two shells in my pocket.

Hastily drawing in our line we paddled rapidly but cautiously down river. We had not covered a quarter of the distance when the wolf disappeared from view, having, we feared, caught sight of us; for the slight breeze that was blowing was in our favor and there was little likelihood that the animal had scented us at that distance. We nevertheless continued towards the spot where it had last been seen and when about a hundred yards distant waited and listened. After what was perhaps not more than two or three minutes we were rewarded by the sound of rustling grass and bushes and the wolf burst into full view directly in front of us. It was now loping, beating after the manner of a hunting-dog and clearly in search of small prey. A number of times as we watched it would turn and trot back a little way to sniff and re-examine hurriedly some spot that it had just passed. Again it would make a short detour into the meadow and be lost from view for what seemed minutes, and each time this happened we feared it would not return; but it always came rushing back to the water's edge to continue on its way, as if it had a definite destination toward which it was heading but could not resist the temptation of a few side excursions en route.

In the meantime we had been urging our canoe nearer and nearer and, by taking advantage of our opportunities when the wolf was for the moment concealed by the tall grass or pre-occupied with its investigations, had by this time approached to within perhaps sixty or sixty-five yards. The wolf was in full view much of the time and it seemed that it must be only the matter of seconds before we should be detected. Two or three times the animal turned on its quartering course and came back a few steps almost directly toward us and I each time carefully laid down my paddle and raised the little gun ready to pull the trigger on the instant that the wolf should show signs of seeing us; for although there was not the slightest chance that two buck-shot might find a vital spot at that distance I felt that we ought not to deny ourselves what satisfaction we might get out of frightening the beast to the utmost of our ability. But the wolf turned and resumed its running hunt, its attention apparently concentrated upon the ground in its immediate proximity.

We followed in the rear and on its left flank. We had been gaining considerably and were not more than forty yards away. The wolf's mouth was open and its tongue slightly extended from its restless activity. At this moment it turned broadside and trotted out onto a little point of land ahead of us. The river is here about seventy-five feet wide but rather shallow, the main channel, which is about fifty feet across, having a depth of only about two and a half or three feet. Without a moment's hesitation the wolf walked deliberately into the river and started swimming. My wife and I stuck our paddles in the bottom and held still, tingling with keenest expectations. Restraining ourselves until the wolf had nearly reached the middle of the channel we shoved ahead and with our best efforts at silence raced to overtake the beast before it should reach the opposite bank, our course lying at an angle of about forty-five degrees.

We had come to within perhaps twenty-five feet of the animal and it was fast nearing the shallow water before it suddenly beheld the rapidly approaching canoe. Abruptly it ceased swimming and for a brief second glared fixedly at the strange sight; then it turned hurriedly about and started back towards the shore it had just left. Checking ourselves we set a diagonal course and with a few vigorous strokes brought up within six or eight feet of the wolf as it now crossed our bow in desperate exertions to reach the land. The little shot gun held true at this distance and both buck-shot entered the brain. The wolf's head sank instantly at the report but its momentum was such that its body doubled up and turned almost completely over in the water.

The wolf proved to be a young male, heavy-boned and in splendid condition. It measured 3 feet, 10 inches, including the tail which was 13 inches long. We had no means for weighing but estimated the weight at about 35 pounds. When the stomach was opened it was found to be completely filled with hair and several pieces of hide of a moose. No other kind of food had apparently been devoured that morning, although the wolf was clearly beating for smaller prey when observed. The pieces of moose hide still had the hair firmly attached but were evidently the dried parts of the skin of an animal that had been dead for some time.

University of Kansas, Lawrence, Kansas.

THE AÑO NUEVO STELLER SEA LION ROOKERY

By Barton Warren Evermann

[*Plates 1-3*]

For many years the relation of the sea lions to the commercial fisheries of the California coast has been a matter of much concern. The commercial fishermen have, with scarcely an exception, contended that the sea lions are very destructive to the fisheries. There are two species, the Steller sea lion (*Eumetopias stelleri*) and the California sea lion (*Zalophus californianus*), and they are both condemned by the fishermen. The former has rookeries from San Miguel Island northward, the latter ranges from San Francisco southward, the two species overlapping at the Golden Gate.

Complaints that the sea lions are very destructive to the fisheries, especially of Monterey Bay and vicinity, come in periodically to the Lighthouse Service and to the California Fish and Game Commission. The commercial fishermen have urged that the seals be exterminated, or at least that their numbers be greatly reduced. Usually these requests have been denied, chiefly on the ground that the feeding habits of the sea lions of the California coast have not been studied sufficiently to determine to what extent, if at all, they are destructive to the commercial fisheries.

In the summer of 1899, the late Prof. L. L. Dyche made some study of this question in and near Monterey Bay. Professor Dyche examined the stomachs of 25 sea lions and found not a trace of fish in any of them. In the summer of 1901, at the instance of the California Fish and Game Commission, the matter was again taken up, and a special commission of three naturalists was appointed to make an investigation. The commission consisted of the late Cloudsley Rutter of the United States Fish Commission, Prof. Edwin C. Starks representing the California Academy of Sciences, and Robert E. Snodgrass for the California Fish and Game Commission. These investigators began their work July 10, at the Purissima rookery, a few miles south of San Francisco. They visited most of the rookeries on the coasts of California, Oregon, and Washington, including Año Nuevo and the Farallons. They killed and examined stomach contents of 18 Steller sea lions and 24 California sea lions. The stomachs of only 26 (13 of each species) contained food. All of the Stellers had eaten fish, and five had eaten squid or octopus. The number of squid was small, six being

the maximum number in one sea lion, while the quantity of fish was large, at least 35 pounds being taken from one stomach. Of the 13 California sea lions whose stomachs contained food, five had eaten fish and eleven had eaten squid. The quantity of fish was trivial, 17 small fish being the maximum, while the remains of 100 to 300 squid were found in each of five stomachs. These studies indicated that the Steller sea lion is largely a fish eater and that the California sea lion feeds chiefly on squid.

Further north, off the mouth of the Columbia, the fishermen claimed that the Steller sea lions do great damage to the salmon fisheries, but Mr. Rutter was not able to secure much convincing evidence.

While the investigations of the Rutter party were not sufficiently comprehensive or prolonged to warrant a final decision, they show rather definitely that sea lions cause very little damage to the fisheries, and the little injury that is done is caused by the Steller sea lion, the California sea lion being almost entirely guiltless.

It is a matter for regret that these investigations were not continued. Apparently no further study of the habits of the sea lions on the California coast has been made since 1901.

Recently representations have been made to Capt. H. W. Rhodes, superintendent of lighthouses, 18th District, that sea lions are doing great damage to the commercial fisheries and permission to kill sea lions on the lighthouse reservations has been requested. On June 24, 1920, the Bureau of Fisheries wired me asking whether I would recommend granting to private companies the privilege of killing sea lions for commercial purposes on the lighthouse reservations. Before replying to the Bureau I decided to visit Año Nuevo Island and make a study of the present condition of that rookery.

This I did in company with Mr. Joseph Mailliard, curator of birds and mammals in the museum of the California Academy of Sciences. Permission to land on the island was given us by Captain Rhodes who also kindly instructed the keeper to show us every courtesy and assist us in everyway possible. We reached the island soon after noon June 27 and remained until noon the next day.

The largest and most important Steller sea lion rookery now on the California coast is that on Año Nuevo (or New Year's) Island. This island lies about one-half mile off shore, 13 miles below the quaint little village of Pescadero, or 63 miles down the coast from San Francisco. The island consists of one main body with an area of two or three acres and a number of outlying rocks upon which the sea lions haul out and

have their breeding grounds. These rocks are a hard, flinty, evenly bedded shale of the Chico Cretaceous, and considerably tilted, the dip being southwest and seaward at an angle of 10 to 50 degrees. The surface is relatively smooth, one end being always a-wash, the other 10 to 20 feet above the water except at unusually high tides or during storms. The island and its outlying rocks constitute a lighthouse reservation and the sea lions and sea birds breeding thereon have always been protected. Permission to kill the sea lions on this rookery has been sought by commercial fishermen and others but has never been granted. Permits have, however, been given on two or three occasions to kill a few animals for museum purposes.

During the time of our visit the weather was ideal and we were able to observe and study the animals quite satisfactorily. We found the sea lions occupying five principal rocks, with a few on two or three smaller rocks. On the five larger rocks the animals apparently covered all the available space; in many places they were lying so close together as to make a continuous mass. On the smaller, lower rocks they were not so closely placed and were moving about more than in the larger, more compact masses. Most of them were quiet and apparently sleeping, but many kept moving about more or less, the old bulls holding their heads high, roaring now and then, often gaping as if drowsy, or chasing other bulls away, sometimes fighting savagely. In these fierce fights between rival bulls the cows and pups often suffered severely. Several old bulls were seen with great gashes or wounds evidently inflicted by their rivals. At least four old bulls were seen so severely wounded that each had withdrawn from the rookery proper and retreated to some rock or unoccupied, isolated station. One large dead bull was seen, evidently killed in some conflict.

The nearest occupied rock contained seven adult bulls, two cows and one pup. This was apparently not a permanent part of the rookery and all the seals took to the water upon our approach. The next rock was completely covered. As a result of four counts, we placed the number on this rock at not fewer than 200. At the right were other sloping smooth rocks on which there were between 300 and 400 seals. A smaller rock beyond these contained at least 100 animals. Still further away were two much larger, oblong rocks, on each of which we counted about 500 seals. To the right of these were some low-lying rocks, always a-wash, on which there were usually 10 to 30 seals. As the seals seemed to come and go on these rocks they probably do not constitute a permanent part of the rookery.

Steller Sea Lion Habitat Group in the Museum of the California Academy of Sciences

It shows a portion of the rookery on Año Nuevo Island. Group prepared under the immediate direction of John Rowley. Background painted by Charles Abel Corwin. Photo by Gabriel Moulin.

Fig. 1. Año Nuevo Steller Sea Lion Rookery

On each of the large rocks in the distance there were about 500 sea lions June 28, 1920.

Fig. 2. Año Nuevo Steller Sea Lion Rookery, in Part

On the rock in the distance there were about 500 animals June 28, 1920. Photos by Joseph Mailliard.

Fig. 1. Año Nuevo Steller Sea Lion Rookery

This part of the rookery contained about 800 animals June 27–28, 1920

Fig. 2. A Portion of the Steller Sea Lion Rookery on Año Nuevo Island

When approached too near the animals take to the water. Note the large number of old bulls. June 28, 1920. Photos by Joseph Mailliard.

As a result of counting the animals six to nine times in each of the groups we agreed that the total number was between 1500 and 2000, with the probability that 2000 is more nearly correct. The two things that impressed us most were the preponderance of adult bulls and the scarcity of pups. The light keeper, J. O. Becker, estimated the number of bulls at twice the number of cows. This may be an overestimate, but it is quite conservative to say that the number of adult bulls is at least half as great as the number of cows. The number of young bulls was also large. The greatest number of cows seen in any one harem was 7; usually there were only 1 to 5.

Very few pups could be seen on the rocks, certainly not more than 100 all told. But in the little nooks and coves, both in the water and on the beach, fully as many more were seen dead or dying. In one place we counted 34 dead pups in the water washing back and forth with the waves. In another protected cove were 24 pups, 19 dead and 5 evidently dying of starvation. In yet other places from 1 to 12 or 15 were counted. The total number of dead or dying pups actually counted was 106; there doubtless were many others. This condition was caused by a severe storm which occurred about the middle of June when the sea washed over the entire rookery, washing practically all the pups off the rocks and into the water. At that time the pups had not yet learned to swim and many were drowned outright. Others were probably so seriously injured they could not get back upon the rocks, and still others were washed ashore. The mothers do not appear to make any search for them and they crawl about and finally starve.

It is quite evident that there is a large excess of adult bulls in the Año Nuevo herd. The presence of these surplus bulls on the rookery results in severe fighting in which cows are injured and pups trampled to death. These surplus bulls should be killed and I have recommended that the Lighthouse Service kill 100 for their hides and oil.

California Academy of Sciences, San Francisco.

NOTES ON THE MAMMALS OF INTERIOR ALASKA

By Lee Raymond Dice

From July, 1911, to September, 1912, the author was in the interior of Alaska serving as deputy fur warden in the Alaska Fisheries Service. During this time a small collection of mammals was made and many notes on habits and distribution were secured. The publication of these notes is with the permission of the United States Bureau of Fisheries.

The regions visited were: Fairbanks, Tanana, Cosna River, the Kuskokwim from the head of the North Fork to Bethel, Takotna, the Yukon from White Horse to Birches and from Russian Mission to the mouth, and St. Michaels. A few records of specimens collected by Chief Warden H. J. Christoffers at Fairbanks are also included. Descriptions of the various habitats of interior Alaska have already been given.[1]

Thanks are due Mr. E. A. Preble for help in identifying the species, and to Dr. B. W. Evermann, then chief of the Alaska Fisheries Service, for coöperation in securing the specimens and notes. The specimens collected are preserved in the National Museum.

ANNOTED LIST OF MAMMALS

Sorex personatus arcticus Merriam. Arctic Shrew.—Taken in white spruce forest, in black spruce forest, in willow thickets, in the grass at lake borders, and among nigger-heads. It occurs in the valleys and along the small streams up to timber-line. The runways of mice, especially of the Drummond vole, are commonly used by it. On January 6, 1912, one was taken in a cabin in the hills near Tanana, where he had been feeding on bacon and dried fish. Specimens were taken at Tanana, Mount Sischu, on the North Fork of the Kuskokwim at its head and at its junction with the McKinley Fork, and others were collected by H. J. Christoffers at Fairbanks. A female taken June 6 on Mount Sischu contained 8 embryos each about 2.5 mm. in length.

Sorex tundrensis Merriam. Tundra Shrew.—One was trapped September 7, 1911, in grass and short brush near nigger-heads in the Yukon Valley at Tanana. June 6, 1912, one was trapped under a log in burned white spruce-paper birch forest on Mount Sischu just below timber-line.

Sorex obscurus obscurus Merriam. Mountain Shrew.—One was captured November 13, 1911, in a cabin 10 miles north of Tanana, where he came to feed on dry fish. Another was trapped in willows beside the Kuskokwim near Aniak, August 12, 1912.

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[1] Dice, L. R., Univ. Mich., Mus. Zool., Occ. Papers, No. 85. 1920.

Microsorex eximius (Osgood). Alaska Microsorex.—A male was taken November 17, 1911, in the nigger-heads of the Yukon Valley near Tanana. This specimen was taken in a trap set in a tiny runway through the snow, which as shown by the tracks had been used a number of times by the shrew. One was trapped in a cabin 10 miles north of Tanana December 30, 1911, and another in the same cabin January 15, 1912.

Ursus alascensis Merriam. Alaska Grizzly.—No certain reports of grizzlies or brown bears were obtained from the valleys of the Yukon or upper Kuskokwim. A bear, probably of this species, was seen in August, 1912, swimming across the Kuskokwim near the mouth of the Aniak River.

Ursus americanus americanus Pallas. Black Bear, or Cinnamon Bear.—Noted at Fairbanks, Tanana, and along the Kuskokwim near the head of the North Fork, just above the East Fork, and at Big River. Tracks were found on mud-bars, and gravel-bars, in willows and alders along the rivers, in white spruce-paper birch forest, and in black spruce forest. Bears are also reported to be frequently found in blueberry patches. At Tanana the last fresh bear signs in 1911 were noted September 10; and at the head of the North Fork of the Kuskokwim the first track in 1912 was found May 7. In May and June signs were numerous near camp at this latter place. June 11 most of the bark was torn off a white spruce tree about four inches in diameter over a space between four and six and one-half feet above the ground. The bear had made no attempt to climb the tree, but had merely clawed it. A female killed by natives on the Redlands River near Tanana, February 8, 1912, contained 3 embryos, each about 5 inches in length. Another female killed about the same time and place contained 2 embryos of about the same size.

Canis occidentalis Richardson. Wolf.—Reported to occur in the region north of Fort Yukon. Reported only very rarely by trappers from the valleys of the Yukon and Kuskokwim and no certain records were obtained.

Alopex lagopus innuitus (Merriam). Arctic Fox.—One is reported to have been taken by a trapper on the Yukon Flats, and it is said by the Indians to cross over occasionally from the Arctic slope.

Vulpes alascensis alascensis Merriam. Alaska Red Fox.—Few in the willows, alders, and cottonwoods, and in the white spruce-paper birch forests along the Yukon and Tanana Rivers near Tanana. Their tracks were frequently seen in snow on the river-bars. On the divides between the Cosna and Kuskokwim, fox tracks were very numerous during March, 1912, in the open blueberry and dwarf birch areas, and to a less extent in the patches of stunted black spruces.

Martes americana actuosa (Osgood). Alaska Marten.—Sparsely distributed throughout the wooded interior of Alaska. It is reported to occur as far west as Georgetown on the Kuskokwim, and Andreafski on the Yukon. Along the main streams and in the other more accessible regions it has been almost completely trapped out. At the head of the North Fork of the Kuskokwim in March, 1912, marten tracks were abundant in the black spruce timber of the low hills, and a few were noted in the adjacent blueberry and dwarf birch patches. No tracks were noted in winter in the white spruce-paper birch forest along the rivers although one specimen was taken December 19, 1911, in a growth of young paper birch, white spruce, alder, and willows on a low hillside near Tanana. In summer, however, martens are reported by trappers to occur commonly in the white

spruce-paper birch forests along the streams. The mating period at the head of the Kuskokwim is apparently in March. March 21, 1912, tracks in the snow showed that a male had been pursuing a female the previous night. April 2 a female was taken containing four embryos, each about 5 inches in length; but another female taken April 16 contained no embryos. The skin of a male caught at the head of the North Fork of the Kuskokwim March 18, 1912, was perfectly prime; a female taken April 2 had several unprime spots on the skin; and the skin of a female taken April 16 in the same locality was very unprime.

Gulo luscus (Linnæus). Wolverine.—Several skins taken in the Yukon Flats were seen. Over most of interior Alaska the wolverine is rare or absent and we saw no signs of it.

Mustela arctica arctica (Merriam). Arctic Weasel.—Specimens were taken at Tanana, at the head of the North Fork of the Kuskokwim, and by H. J. Christoffers at Fairbanks. Tracks have been noted during the winter in nigger-heads, in the grasses and in sedges about lakes, in willows and alders along streams, in white spruce-paper birch forest, in black spruce forest, in burned forest, and in patches of blueberries and dwarf birches both in the valleys and on the hills at timber-line. One inhabited the walls of a cabin in the hills north of Tanana during October and November, 1911. Owing to their small value trappers seldom make any special effort to trap ermine, though quite a number are taken in marten traps. October 5, 1911, a male was obtained by H. J. Christoffers near Fairbanks on which the head and tail were mostly brown, the back about half white, and the belly pure white. Four days later a completely white male was obtained in the same region. At Tanana a fully white weasel was seen October 1. Weasels which were watched feeding on frozen pieces of rabbit and grouse did not handle nor hold the food in any way with the feet, but only with the mouth. When running the tail is carried off the ground usually at an angle of about 45 degrees. Weasels when excited were several times heard to give a bark, somewhat similar to the bark of the mink, though not so loud.

Mustela vison ingens Osgood. Alaska Mink.—Common along the streams and lakes west to Bering Sea. Tracks were frequently noted on river-bars, in lowland willows and alders, in white spruce-paper birch forest, and in nigger-heads. Minks are most common in the grasses and sedges about lakes and swamps. Tracks of a few individuals were noted in black spruce forest on low hills, but these were apparently traveling overland from one river or lake to another. A specimen taken by H. J. Christoffers near Fairbanks August 1, 1911, was very fat and the skin was unprime. Two young taken near Tanana November 7 had skins not fully prime. The skin of a male taken March 9, 1912, near the head of the North Fork of the Kuskokwim was fully prime, but the skins of two males taken at the same place April 23 and May 2 respectively had unprime spots. The skin of a partial albino was seen in the possession of a trader at Tanana. A female taken May 13 near the head of the North Fork of the Kuskokwim contained a number of embryos, each about 16 mm. in length. A mink which entered a cabin north of Tanana to obtain some frozen pieces of grouse was watched for over an hour on the evening of November 1, 1911, at a distance of six feet. In feeding, it never used its front feet to handle or hold the food in any way, but manipulated it entirely by the mouth. When caught in a trap the mink often gives a hoarse bark.

Lutra canadensis canadensis (Schreber). Canada Otter.—Several were trapped by Indians in the winter of 1911 on Sullivan Creek near Tanana. Otters were reported to be common at the heads of the Tozi and Melozi. In March and April, 1912, trails and slides were common along the North Fork of the Kuskokwim near its head. The trails led from the water-holes of the river to the snow-covered river-bars, and also into willow thickets and into the adjacent white spruce-paper birch forest. One was seen swimming in the Kuskokwim near Big River on July 13. The species is reported to occur commonly on the Bering Sea tundra near Bethel. A male trapped at the head of the North Fork of the Kuskokwim April 7, 1912, was very fat and weighed 13 pounds.

Lynx canadensis Kerr. Canada Lynx.—A few tracks were noted near Tanana, along the Cosna River, and near the head of the North Fork of the Kuskokwim. Its trails were found in willows along the streams and in white spruce-paper birch forest. In walking in soft snow it apparently tries to step each time in its previous tracks. This habit is sometimes taken advantage of by trappers, who place a trap under one of the tracks.

Synaptomys dalli Merriam. Dall Lemming-Vole.—One was taken in scrub willows at the bottom of a small valley 10 miles north of Tanana December 2, 1911. Another was taken July 4, 1912, from the runway of a Drummond vole in horsetails near a lake at the junction of the McKinley Fork with the Kuskokwim.

Lemmus yukonensis Merriam. Yukon Lemming.—Two young were taken June 12, 1912, in grass mostly of the tussock type, at the border of a small lake near the head of the North Fork of the Kuskokwim. Continued trapping in the region failed to secure any more specimens.

Evotomys dawsoni dawsoni Merriam. Dawson Red-backed Vole.—The most abundant mammal of interior Alaska. It was taken in equisetum, sedges, and grassy areas about lakes; in nigger-heads; in willows and alders, both in the larger valleys and at timber-line; in paper-birch forest, white spruce forest, and black spruce forest; in growths of blueberries and dwarf birch, both in the valleys and above timber-line; on the high ridges above timber-line in sphagnum, grass, and low brush; in cabins and caches in the woods; and in burned timber. It was found most abundantly under shrubs in the black spruce forest. Specimens were preserved from Fairbanks, Tanana, Mount Sischu, and Takotna; and on the North Fork of the Kuskokwim from near the head of the stream, from the junction with the McKinley Fork, and from near the East Fork. At Bethel one was taken at the border of the tundra in a tent pitched at the edge of a slough.

This mouse makes short runways under logs and low bushes, but in general its runways are not well defined, for it does much traveling without following a definite path. It has also been taken in the runways of the Drummond vole. In the winter it, as well as the other voles and the shrews, pushes its way at the surface of the ground through the very light snow. These burrows may be used only once, as shown by the tracks, or they may be traveled enough to form runways. Mice and shrews also sometimes come to the surface to travel, especially when the snow is crusted. Red-backed voles cause some inconvenience to trappers by feeding on stored food, by eating bait, and sometimes by springing the traps set for marten or mink. A female taken at the head of the North Fork of the Kuskokwim May 21, 1912, contained four embryos each about 10 mm. in length; and one taken May 27 showed recent birth of young. One taken above timber-line

on Mount Sischu, June 5, contained six embryos. A female with a black dorsal stripe instead of red was taken June 5 on Mount Sischu and a male with the same coloration was secured June 12 beside the North Fork of the Kuskokwim River near its head. All other specimens seen were in the normal color.

Microtus pennsylvanicus drummondi (Audubon & Bachman). Drummond Vole.—The voles of the *M. pennsylvanicus* group occurring in the interior of Alaska differ from typical *drummondi* in being much larger and in being decidedly darker in color. Two were taken at Tanana in the nigger-heads of the Yukon Valley. Along the North Fork of the Kuskokwim a few were taken near the head of the stream; and they were common at the junction with the McKinley Fork and above the East Fork, occurring about small lakes in horsetails, in sedges, in grasses, and in willows. Several were taken during August, 1912, in the short grass and moss at and above timber-line on the hills near Takotna. A female taken June 17, 1912, at the head of the North Fork of the Kuskokwim contained nine embryos, each about 18 mm. in length. Another taken July 3 at the junction with the McKinley Fork contained 7 embryos. Many young were taken between July 3 and 12.

Microtus operarius operarius (Nelson). Tundra Vole.—The runways of this vole were very numerous in the grass along the banks of a slough at Bethel, and a number of specimens were trapped August 21–23, 1912.

Microtus operarius endœcus Osgood. Interior Vole.—A female containing five large embryos was taken August 4, 1911, in brush and grass in a burned white spruce-paper birch forest on the shores of the Tanana River near Fairbanks. Others were taken near Tanana during the fall and winter in the nigger-heads of the Yukon Valley, in willows along a little creek in the hills, and under shrubs in a burned black spruce forest. In these places it apparently uses the same runways as the red-backed vole. The winter pelage of the interior vole is strikingly different from the summer pelage, being much heavier in fur and lighter in color.

Microtus xanthognathus (Leach). Chestnut-cheeked Vole.—Several specimens were taken in 1911 by H. J. Christoffers south of Fairbanks in a swampy region sparsely covered by cut-over spruce. Another specimen was secured near the mouth of the Takotna River in the winter of 1912–13 by Mr. Edward Cone.

Fiber zibethicus spatulatus Osgood. Northwestern Muskrat.—A few are reported from the small streams and lakes near Tanana. Several were seen in a small lake near Lake Minchumina, and one muskrat house was noted June 23, 1911, among the horsetails at the edge of this lake. In a small lake near the junction of the East and North Forks of the Kuskokwim trails were noted in horsetails and in sedges, and one individual was seen. Several were seen in the Takotna River and one shot August 2. Muskrats are reported to be abundant along the lower Kuskokwim and lower Yukon. A female taken May 8, 1912, in a small lake near Lake Minchumina contained no embryos and had a prime skin. A male taken in the same lake June 23 had an unprime skin. The Indians use the muskrat extensively for food. The usual method of securing it is by shooting in the spring after the ice has broken in the sloughs and lakes.

Rattus norvegicus (Erxleben). Norway Rat.—Common during the winter of 1911 in the warehouses and stores of Tanana. Four specimens were taken.

Erethizon epixanthum myops Merriam. Alaska Porcupine.—A specimen was taken by H. J. Christoffers beside a small slough about nine miles from Fairbanks where tooth marks were numerous on small alders and white spruces. Another specimen was taken July 9, 1912, under a growth of large willows along the North Fork of the Kuskokwim a few miles above the East Fork. It is reported to be numerous along the Kuskokwim below Georgetown, and one was seen August 12 on the gravelly shores of the river below the mouth of the Aniak River.

Citellus osgoodi (Merriam). Yukon Ground Squirrel.—Reported by natives to occur in the mountains northeast of Tanana and in the mountains near Takotna.

Sciurus hudsonicus hudsonicus Erxleben. Northern Red Squirrel.—Common at Fairbanks, Tanana, and along the Kuskokwim at the head of the North Fork, at the junction with the McKinley Fork, and near the mouth of the Takotna River. A few were seen along the Takotna River and near the mouth of the Aniak River. It lives in the forests of white spruce and also occurs rarely in black spruces. It is seldom seen far from spruces probably because of its dependence upon these trees for food. In opening the cones it bites off the scales beginning at the base. Huge piles of the discarded scales mark the places where the squirrels live. October 16, 1911, one was observed to bite off and eat the buds of black spruces. The nests are placed from six to twenty feet above the ground in large white or black spruce trees. Often several are found close together in the same tree or in adjacent trees. They are supported by some of the smaller branches and are usually though not always placed near or against the tree trunk. These nests are spherical structures mostly of dried grass, each nest being about a foot in diameter. No food or excreta was found in the few nests examined.

In the fall of 1911 before the snow became deep, spruce cones were collected in great numbers and either buried in the ground, placed in the branches of trees, piled on the ground, or stored in the old piles of scales. At the bottoms of the trees in which squirrel nests were placed, piles of cones a foot to two feet in height and extending four or five feet around the tree were made. Near Tanana the first cutting and piling of the cones was noted September 6, and the work was still in progress though nearly complete on October 13. The cones may be cut singly, but often they are cut in the natural clusters of several cones and stored in that shape. September 6, 1911, near Tanana a red squirrel was watched while he was cutting cones from the top of a high white spruce. The cones were thrown away from the tree by a backward toss of his head and fell in all directions. He seemed to have no regular method of going over a branch for its cones, and I think several times returned to the same branch. During fifteen minutes he worked continuously, dropping cones sometimes one per second, though they usually fell more slowly. No other squirrels were near, but twice during the fifteen minutes he stopped to give his rattle.

A red squirrel on October 1, 1911, had a nest on a shelf in an old cabin north of Tanana. This squirrel had collected a great many mushrooms and stored them on the shelves. Those not entirely dry were spread out separately from the others. Every open can in the cabin was packed tightly with the dried fungi. A grouse head later put out for a weasel was picked up by the squirrel and placed with the mushrooms.

When the temperature drops below $-30°F.$ very few squirrels are active, and they become dormant at lower temperatures. Trails are worn in the snow connecting the various trees visited by the squirrels, and sometimes tunnels through the snow are used for the same purpose. When passing from tree to tree on the ground the squirrels usually run hurriedly and often whimper nervously as though afraid. Squirrels bother trappers by springing the traps set for fur animals. This is perhaps done out of curiosity, as no case was observed where the squirrel had eaten the bait or disturbed any animal taken in the traps. A red squirrel struggling with a half-grown mink was noted July 15, 1912, on the bank of the Kuskokwim a short distance above the mouth of the Takotna River. Our boat drifted by before the result of the struggle could be determined, but the squirrel was constantly screaming, and it seemed certain that the result would be a victory or the mink.

Mating behavior in 1912 was first noted at the head of the North Fork of the Kuskokwim on March 1. A squirrel about half-changed to summer pelage was seen at that place June 10. One child's parka (outer winter garment) of red squirrel skins was seen near Tanana, but the fur is not used to any extent by the Indians and is seldom purchased by traders.

Glaucomys sabrinus yukonensis (Osgood). Yukon Flying Squirrel.—One was trapped October 15, 1911, and two November 2, in a white spruce and paper-birch forest in the hills 8 miles north of Tanana. One specimen was taken in a steel trap set near a stump and baited with a grouse head. This animal and another specimen caught at the same place in a mouse trap had bitten off and destroyed their tails before dying. A third specimen caught in a rat trap and held in such a manner that it could not reach its tail was in perfect condition.

Castor canadensis canadensis Kuhl. Canada Beaver.—A number of workings were noted at the head of the North Fork of the Kuskokwim; ten skulls were seen on the roof of a cabin at the junction with the McKinley Fork, evidently taken at that place, and beavers were reported on good authority to occur rarely along the Takotna River. The Indians are very fond of beaver flesh, and they are said to kill them in spite of the closed season.

A beaver house was located near the spring camp at the head of the North Fork and a number of observations were made on the members of this house. The house was placed on the lower end of a point of land where a slough joined the Kuskokwim River, here about ten yards in width. The number of individuals living in the house was five, as nearly as could be determined. Willow cuttings were extensive along the slough above the house, along the river above the house, along a small slough entering the river opposite the house, and for a short distance down the river below the house. A few poplars and small birches had been cut down. A small dam of sticks and mud was thrown across the mouth of the small slough opposite the house.

The beavers first appeared in the spring of 1912 on April 28, when the water had risen in the river and the ice was going out. On that date two beavers were seen about 5 p.m. in the slough near the house. By May 3 the ice had cleared out of this part of the river, and a number of fresh cuttings appeared in the nearby willows and birches.

The beavers were to be seen only during the darker part of the night; during June, however, this was only a slightly modified daylight. In April they usually

started work about 6 p.m., but toward June 15 they did not come out till nearly 11. In early May they continued operations till about 7 a.m., but in the longer days of June they were not often seen after 5.

Each individual as he came out of the house in the evening seemed to spend a few minutes swimming about, at intervals slapping his tail and diving. In these dives the animal remained down only an instant and then immediately reappeared and continued swimming. In such cases the other beavers showed no alarm at the splashing. However, they can dive silently and when at work they do not slap with the tail. When really alarmed a beaver dives with a loud slap and remains down a long time. Sometimes when one beaver became scared and dived with a resounding flap of his tail another not far distant continued unconcernedly eating or working, though usually the danger was noticed by all. This indicates that the splash is not always an alarm-signal.

Sticks were usually held in the mouth while being carried up on the house or dam, and the fore feet were often used to help balance or hold the material. Sometimes two or more small pieces were carried at one time. In placing a stick one end was inserted among the material already in place and the stick pushed in as far as possible by sidewise pushes of the animal's head. It was a frequent habit for the animal to walk on the hind legs and tail when carrying material. Several individuals were noted at different times in shallow places near the banks feeding on sticks with green bark. The fore feet were used to manipulate the stick and to hold the pieces of bark cut off by the incisors. The stick was continually turned on its axis, and as the bark was removed the stick was pushed endwise through the mouth, so that the portion of stick gone over was completely stripped of its bark.

Lepus americanus macfarlani Merriam. Macfarlane Snowshoe Hare.—Records were secured from Fairbanks, Tanana, Cosna River, and along the Kuskokwim from the head of the North Fork down as far as the East Fork. It was abundant in 1911 and 1912 in the willows, both along the streams and at higher elevations, and in white spruce-paper birch forest. A few were found also in black spruce forest. In summer it plays in the evenings and mornings on the river-bars. In this region as elsewhere in its range it has years of abundance succeeded by years of scarcity. In the winter of 1911–1912 the hares were approaching their maximum abundance.

These hares feed mostly on the bark and small twigs of willow and paper birch, but in winter hunger sometimes drives them to eat alder and spruce. On willow-bars along the rivers in winter they often cut down the young willows almost to the surface of the snow, eating stems up to three-eighths of an inch in diameter. Sometimes they nibble the moss and snow along the sled trails, apparently to secure the salt. Most of their foraging is done at night or in twilight, and it is seldom that they are seen moving about in the daytime. In winter they sometimes make their forms under branches laden with snow, but they apparently never burrow into the snow. They usually use an uncovered form which is only partly protected on the sides.

About September 1, 1911, at Tanana some of the hares had started to turn white, beginning on the feet and ears. They were all changed by the last of October, though many were fully white long before that time. In the spring of 1912 at the head of the North Fork of the Kuskokwim they started to change

color about the first of April, and by the end of the month most of them were brown.

On July 25, 1911, half-grown young were numerous at Tanana. August 2 a female containing six large embryos was taken at Fairbanks. At the head of the North Fork of the Kuskokwim a female containing a number of formless embryos was taken May 3, 1912, and one with 3 embryos, each about 110 mm. in length, on May 15. May 29 a juvenile about one-third grown was seen. A female with 6 large embryos was taken June 24 on the Kuskokwim-Minchumina portage.

Except during the breeding season, when they are stated to be strong in flavor, the hares are used a great deal for food, especially by natives and by prospectors. They are commonly taken in snares of picture wire set over the runways in the snow. The snares used by the Indians are attached to a spring-pole, but white men commonly attach the snare merely to a short stick, which is stuck in the snow. The natives sometimes organize a small drive, and then take the hares in snares or shoot them with a small rifle.

Alces gigas Miller. Alaska Moose.—A few tracks were noted during August, 1911, in the Tanana Valley near Fairbanks. In the neighborhood of Tanana moose have been entirely killed off, but a few still occur at the heads of the Cosna and Redlands (Chitanana) rivers. Along the North Fork of the Kuskokwim they are numerous down as far as the McKinley Fork, and are reported to be rarely found west to Big River. Tracks were found in white spruce-paper birch forest, in lowland willows and alders on river-bars, in areas of nigger-heads, in black spruce forest, and in burned timber. In summer moose frequent the edges of lakes, and several were seen swimming in lakes and wading in rivers. July 4, 1912, one was watched feeding on horsetails at the edge of a small lake on the North Fork of the Kuskokwim at the junction with the McKinley Fork. In winter they feed on the twigs of willow and birch.

Rangifer stonei Allen. Stone Caribou.—A few caribou were reported to occur on the hills about fifty miles north of Tanana. Many old trails were noted in grass and sphagnum on the ridges of Mount Sischu and near Takotna in the summer of 1912, but caribou are rare in those regions. In the early winter of 1911–12 a band of about ten visited Mount Unsuzi at the head of the North Fork of the Kuskokwim, where tracks were noted in black spruce forest. In the region between Fairbanks and Circle caribou are reported to be abundant.

Ovis dalli dalli Nelson. Dall Sheep.—Reported to occur on the northern slopes of the Alaska Range.

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THE STATUS OF MERRIAM'S SHREW (SOREX MERRIAMI)

By Hartley H. T. Jackson

There is so little generally known about the shrews *Sorex merriami* Dobson and *Sorex leucogenys* Osgood, that a brief summary of our present knowledge of these two forms might not be amiss and might stimulate men doing zoological field work to make a special effort to secure more of these rare mammals and learn something of their habits.

Once one has become familiar with these two shrews they are comparatively easily distinguished from other forms. In size they are somewhat larger than individuals of *Sorex personatus*, rather pale (a grayish drab above), and with distinctly whitish underparts and feet. The skull is relatively short and broad, flattened through the braincase but relatively high and swollen interorbitally, with a short, broad rostrum, which, compared with that of other members of the genus found within its geographic range, is abruptly truncate anteriorly (nares region). The third upper unicuspidate tooth of most of the west American shrews is smaller than the fourth. Exceptions to this are found in *Sorex personatus* and *Sorex richardsonii*, both species which may possibly occur within certain parts of the geographic range of shrews of the *merriami* type, and, like them, have the third upper unicuspid larger than or, infrequently in *personatus*, equal to the fourth. Both *merriami* and *leucogenys*, however, have the unicuspids relatively narrow and elongate, and tending to be more crowded together than in *personatus* or *richardsonii*. A glance at the accompanying figures will enable one to grasp some of the differences in the rostra and dentition. In the scanty material available there appears no difference in color between *merriami* and *leucogenys*. The latter, however, is slightly larger than *merriami* and shows cranial differences in being distinctly higher through the braincase and having the anterior halves of the unicuspidate tooth rows less approximated and less nearly parallel.

The type-specimen, an adult female, skin and skull in good condition, is the only known specimen of *Sorex leucogenys*. It was caught August 12, 1908, about 200 yards from running water on a dry rocky Upper Sonoran slope, where the vegetation was scant and practically restricted to *Juniperus*, *Artemisia*, and *Atriplex*, about 3 miles east of Beaver, Beaver County, Utah (Osgood, W. H., Proc. Biol. Soc. Washington, vol. 22, p. 52, April 17, 1909).

The type-specimen of *Sorex merriami* is an alcoholic with skull removed. The skull is practically perfect. It was collected by Maj.

Charles E. Bendire, who caught it at the post garden, on the Little Bighorn River, about 1½ miles above Fort Custer, Montana (Merriam, C. H., North Amer. Fauna, no. 10, p. 88, Dec. 31, 1895). Since then four additional specimens of this rare mammal have come to light, all of them now being in the Biological Survey Collection. Unfortunately, none of these is a perfect specimen.

On June 23, 1896, Mr. Vernon Bailey found a dead and dried shrew in a creek valley, 7 miles southeast of Antelope, Oregon. In his field notes Bailey remarks: "It may have been killed near the creek or may have been brought from a distance, as the valley is mainly Sonoran.

1 2 3

Fig. 1. Lateral View of Rostrum and Unicuspids of *Sorex personatus personatus* (× 6)

No. 227410, United States National Museum, Biological Survey Collection; from Crescent Lake, Oneida County, Wisconsin.

Fig. 2. Lateral View of Rostrum and Unicuspids of *Sorex merriami* (× 6)

No. 186441, United States National Museum, Merriam Collection; from Fort Custer, Montana.

Fig. 3. Lateral View of Rostrum and Unicuspids of *Sorex richardsonii* (× 6)

No. 69163, United States National Museum, Biological Survey Collection; from South Edmonton, Alberta.

Perodipus tracks and holes were common all around where the *Sorex* was picked up." From this specimen, a mere fragment of skin and body which has been in alcohol, I have had the partly crushed skull removed and find it agrees well with that of the type of *Sorex merriami*, except that it seems to have been a trifle higher through the braincase.

The remains of a small shrew were found among the rocks on a high butte near Medora, North Dakota, on June 13, 1913, by Mr. Stanley G. Jewett. Some animal had killed the shrew and eaten its head, so that all available for study is the skin of the hind half of the body, the hind feet, and tail. The color indicates that the specimen is with little doubt *Sorex merriami*.

Another specimen (skin and broken skull) was secured by Mr. Edmund Heller, November 26, 1914, at Desert Ranch, 100 miles northeast of Golconda, Elko County, Nevada, where it had been caught by a house cat. The skull of this specimen is slightly larger and has a somewhat higher braincase than that of the type-specimen of *S. merriami*, but it is decidedly more nearly like this form than *S. leucogenys*.

The last specimen to make its appearance, a skin accompanied by a broken skull, was collected by Mr. George G. Cantwell, November 18, 1919, at the entrance to an old badger digging on top of a "high bunch grass hill," at Starbuck (altitude 645 feet), Columbia County, Washington. It shows no appreciable differences from the type-specimen of *merriami*.

The specimens enumerated above represent all that are to be found of these species in the larger American collections. It can be seen that we have entirely insufficient material with which to work out the relationships of the two forms. Moreover our entire knowledge of the habits of these mammals is disclosed in this brief account, the outstanding fact being that these shrews are rather aberrant in their habitat, as compared with other American members of the genus *Sorex*, in that they inhabit an arid sagebrush association of the Sonoran Zone. It is hardly probable that these little mammals are anywhere very abundant. On the other hand, in view of their extensive geographic range, it does not seem probable that they are actually as rare as the few present in collections would indicate. We are accustomed to looking for shrews in their time-honored habitats among mossy logs, along grassy streams, and in damp woods. It seems very possible that a methodical search in proper ecological associations in favorable localities, with the definite object of *Sorex merriami* or *Sorex leucogenys* in mind, might produce results.

Biological Survey, Washington, D. C.

JOHN MACOUN, 1832–1920

By R. M. Anderson

Professor John Macoun, M.A., F.L.S., F.R.S.C., the dean of Canadian naturalists, died at his home in Sidney, Vancouver Island, British Columbia, on July 18, 1920, aged a little over eighty-eight years. He was born near Belfast, Ireland, April 17, 1832, and came to Canada with his parents in 1850. A number of his early years he spent in teaching school, terminating that career as professor of natural science at Albert College, Belleville, Ontario, in 1882, at which time he became naturalist of the Geological Survey of Canada.

Before that time, however, he had done considerable work for the Government, joining Sir Sanford Fleming's exploratory party in 1872 at Port Arthur, and crossing the plains. From Edmonton he went with a small party through the Peace River Pass to the coast. Three years later he again crossed the continent traveling from the Pacific coast eastward. In 1879, 1880 and 1881, he exhaustively explored the little known parts of the Great Northwest country, and his capable reports had a great deal to do with making known the immense potential resources of that vast territory which is now the great grain-producing region of Canada. From his profound knowledge of field botany, the relation of wild plant ecology to agriculture, and the time required for ripening of seeds of the native flora, he was fully convinced of the agricultural possibilities of the prairie provinces of Canada, at a time when the Canadian Pacific Railroad was still unbuilt, and the future of the great west of Canada was considered by most people a speculative dream.

In devoting his energies to diffusing correct knowledge of the west, Professor Macoun was for a long time regarded as a more or less visionary enthusiast, but time has justified his prophecies and he is entitled to rank as an empire builder of the best sort. His book entitled "Manitoba and the Great North-west," 687 pages, published privately by World Publishing Co., Guelph, Ontario, 1882, gives a graphic description of the pioneer conditions on the prairies, and much of natural history interest. Chapter XX, Mammals of the North-west, pp. 324–353; Chapter XXI, Birds of the North-west, pp. 354–373; and Chapter XXII, Notes on Reptiles, Fishes and Insects, pp. 374–398, give much valuable data of long-gone faunal conditions.

The Annotated Catalogue and Guide to the Publications of the Geological Survey of Canada 1845–1917, gives 61 titles of Professor

Macoun's writings on natural history subjects, covering all parts of the Dominion from the Atlantic maritime provinces to the Yukon. Many of these are buried in the Report of Progress, Annual Reports and Summary Reports of the Survey from 1875 to 1915. The reports of earlier times particularly, when field trips were largely reconnaissance of virgin fields and before government publications were as specialized as at present, were often enlivened by much varied information of general interest by keen observers like Macoun. His most important technical papers were the Catalogue of Canadian Plants, Part I, *Polypetalae*, 1883; Part II, *Gamopetalae*, 1884; Part III, *Apetalae*, 1886; Part IV, *Endogens*, 1888; Part V, *Acrogens*, 1890; Part VI, *Musci*, 1892; Part VII, *Lichenes* and *Hepaticae*, 1902.

Professor Macoun resided in Ottawa until 1912, when failing health caused him to move to the milder climate of British Columbia. Here he continued actively at work, specializing on the mosses and fungi of British Columbia, and up to the last months of his life contributed articles on local botany to the press. For about forty years he was assisted by his son, Mr. James Melville Macoun, C.M.G., F.L.S., also a noted naturalist and recently botanist and chief of the Biological Division, Geological Survey of Canada, and the work of the Macouns founded the National Herbarium of Canada and built it up to over 100,000 specimens.

The late Professor Macoun, while best known as a botanist, was one of the old school of naturalists who took the whole field of natural science for his province. Writing of him as a field worker, one of his old scientific friends said in 1917, "He did not do much work with the microscope, but few men have the power to do what he could with the eye. His power and facility to set a present percept against a remembered image and perceive the likenesses and differences was marvellous. And he can exercise the power yet." In addition to his botanical work as naturalist of the Geological Survey from 1882, he gathered a collection of several thousand birds and about 2,000 mammals, before giving up active museum work. He was an associate member of the American Ornithologists' Union from 1883 for many years. As an ornithologist he contributed many notes to the old *Ottawa Naturalist*, and his best known work was the Catalogue of Canadian Birds, Part I, Water Birds, Gallinaceous Birds and Pigeons, 1900; Part II, Birds of Prey, Woodpeckers, Flycatchers, Crows, Jays and Blackbirds, 1903; and Part III, Sparrows, Swallows, Vireos, Warblers, Wrens, Titmice and Thrushes, 1904. As this contained most of the published refer-

ences to distribution and habits of Canadian birds, and a large amount of new material from Professor Macoun's numerous correspondents as well as a great deal of information based on his own extensive field notes and experience in all parts of Canada, there was such a demand for this publication that it was soon out of print, and in 1909 a new revised and enlarged edition of 761 pages was published in one volume, both English and French editions. The 1909 edition bears also the name of James M. Macoun, assistant naturalist, as collaborator.

As a mammalogist, Professor Macoun did not publish so much, although he was keenly interested in the mammals of Canada. He was a charter member of the American Society of Mammalogists. Many years ago he considered the publication of a catalogue of Canadian mammals, somewhat similar to his Catalogue of Canadian Birds, and began a list of species, working up a partial synonymy and notes on distribution, but advancing years and lack of sufficient material caused him to lay this work aside when he left Ottawa. Professor Macoun was always liberal with his material, whether botanical or zoological, and a good part of the rather extensive small mammal material collected by himself and his son and by Mr. William Spreadborough, his field assistant for many years, notably along the International Boundary in Saskatchewan, Alberta and British Columbia, was sent to Washington from year to year for comparison by the United States Government scientists, with many of whom he carried on an extensive correspondence.

Professor Macoun received many honours in his time. He was a charter member of the Royal Society of Canada, a member of the Linnæan Society, and received the degree of M.A. from Syracuse University. In consideration of his distinguished scientific work for his government, a special Order-in-Council was passed at the time Professor Macoun left Ottawa, retaining him on the active list on full pay for life.

One genus, *Macounastrum*, and forty species of plants bear his name, as do two mollusks, *Boreotrophon macouni* and *Turbonilla* (*Pyrogalampros*) *macouni* Dall and Bartsch; one starfish, *Leptasterias macouni* Verrill; one beetle, one butterfly, *Oneis macounii* Edwards; and a viperfish, *Chauliodus macouni* Bean.

In 1862 Professor Macoun married Miss Ellen Tyrrell, who survives him. In addition he is survived by his son, Mr. W. T. Macoun, Dominion horticulturist, Ottawa, and three daughters, Mrs. A. O. Wheeler of

Sidney, B. C., Mrs. R. A. Kingman, Wallingford, Vermont, and Mrs. Wm. M. Everall, Victoria, B. C. His eldest son and lifelong assistant Mr. James M. Macoun died at Ottawa in January, 1920.

Victoria Memorial Museum, Dept. of Mines, Ottawa, Canada.

GENERAL NOTES

NOTES ON THE HABITS OF BLARINA BREVICAUDA

While I was in camp at Lake Missanag, Ontario, in August and September, 1919, two short-tailed shrews (*Blarina brevicauda*) came about the tent frequently, and I was able to learn something of the habits of these usually rather elusive little mammals.

They were active both by day and night. By day they avoided brightly lighted spots, traveling to the tent under the cover of dead leaves, herbs, and logs; and passing over open places like a flash. In the tent they kept mostly close to the side-walls, or to the pile of wood beside the stove. They were ceaselessly active, never resting for a moment unless engaged in eating something. They kept up a continual, rather musical, chirping squeak, which resembled very strongly the twitter of American goldfinches. This "song" of theirs was loud enough that we could hear them coming some time before they entered the tent.

The Blarinas fed on insects, both living and dead. They caught and consumed all the crickets (*Gryllus assimilis* and *Nemobius fasciatus*) which previously had been common under the sod-cloth along the base of the walls of the tent, and also devoured any dead insects which I had rejected after killing in the cyanide bottle. On one occasion I saw one of them jump repeatedly at a sphinx larva which was suspended on a dead poplar twig a few inches above the ground, and at last succeed in pulling it down and into a tunnel in the dried grass. They ate with avidity anything of an animal nature, including pieces of salty chipped beef, and their particular delight was to get into the frying-pan and feed on the cold fat which it contained. So engrossed did they become in their gormandizing of this fat that they paid no heed to my presence and several times I took up the pan and walked about with it while they were thus engaged. They were not at all expert climbers and it was quite a feat for them to clamber over the high edge of the frying-pan. Once on top of the edge they tumbled in head-first.

In hunting for food they seemed to depend entirely on their sense of smell, and when thus prospecting they wriggled their long pink snouts continuously and inserted them into every nook and crevice. They appeared to use their eyes merely in avoiding well-lighted situations.—A. Brooker Klugh, *Queen's University, Kingston, Canada.*

RED BAT AT SEA

On the first day of September, 1920, when still 3 days out from Philadelphia on our voyage from Cape Town, South Africa, I found a red bat (*Nycteris borealis borealis*) clinging to the ledge under the manger of the giraffe box. The record may be of interest to American mammalogists.—A. K. Haagner, *Pretoria, South Africa.*

THE BLACK BEAR AS A DESTROYER OF GAME

On June 12, 1920, while approaching a camping site on the Lamar River, Yellowstone National Park, in company with M. P. Skinner, park naturalist, I noted a black bear (*Ursus americanus*) hunting around through the sage brush on a nearby hillside. Five minutes later we stopped for the night, and as I descended from the machine, I turned my ten power glasses on the bear, and was surprised to see that he was making off, at a leisurely gait, with an elk calf in his mouth. He paid not the slightest attention to the presumable mother of the calf, which followed him anxiously within fifteen or twenty feet; she, in turn, being followed by three other cows. Shortly, the bear entered a small grove of aspens into which the cows were afraid to follow, and they walked back and forth along the border of this for some time. Three of the cows soon dispersed, but the fourth wandered about disconsolately until dark.

When with the cows, the elk calves are reasonably safe, but the latter are usually hidden in the brush or forest while their mothers are feeding in the meadows, and it is at such times that the bears have a chance to make a meal, which opportunity, according to Skinner, they never fail to embrace. I have observed the "hidden" calves in the woods, and have noticed that as long as a person is in motion, although only six feet away, the calves remain absolutely still, with neck extended along the ground, but the instant the person stops, they are up and sprawling through the timber at their best gait. These notes may be of interest to those who contend that the black bear is harmless to game, and confines his attentions to more humble fare.—A. Brazier Howell, *Pasadena, Calif.*

THE TREE-CLIMBING WOLVERINE

Perhaps no apology is needed for this addition to my note on the tree climbing of the wolverine recently printed in the Journal, but I regret that it was delayed.

Mr. John B. Burnham of New York, who went to Alaska at the time of the Klondike excitement, tells me that wolverines climb trees, and that this habit is well known there. These animals are constant plunderers of tree caches—stores of food or other articles placed high up in trees to protect them from the ravages of ground dwelling animals—and such tree caches are always built, where this is possible, with an overhang to prevent the wolverine, when it climbs the tree, from reaching the platform on which the articles are placed. When available, sheet iron or tin is sometimes nailed around the trees below the cache to make climbing more difficult.

In the winter of 1897–98, a wolverine one night climbed a single spruce tree standing near the corner of Mr. Burnham's cabin, and pulled down a piece of meat that had been hung on a limb seven or eight feet above the ground. The wolverine's tracks were plain in the snow, and its claw marks on the bark of

the tree. This wolverine frequently visited the neighborhood of the cabin, and at length was trapped in a dead fall strong enough and heavy enough, it was thought, to have held a young bear. The animal was not killed—although the fall log and what had been put on it must have weighed 800 or 1000 pounds—but pulled itself out and went off, leaving blood and hair which told unmistakably what animal had been caught.

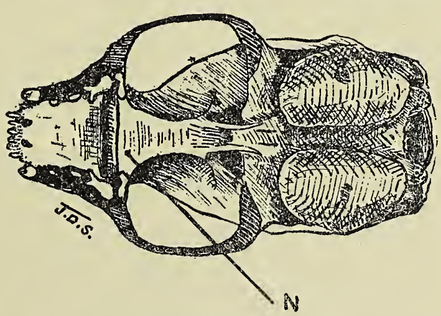
Mr. J. P. Holman of New York has often seen in Alaska caches protected by tin nailed about the tree trunks.

Mr. T. H. Bowler, M.E., of New York, a former member of the Northwest Mounted Police, states to me that there is no question but that wolverines climb trees to rob caches. He also speaks of the common practice of splitting tin coal oil cans and nailing them around the tree trunks below the caches to prevent the wolverines getting support for their claws. Notwithstanding this precaution, he knows of instances where wolverines have robbed caches in trees that were thus protected.

Apropos of the ancient story that the wolverine throws down bits of moss to attract the deer under the tree in which he is concealed, an observation by Mr. Burnham seems interesting. In his deer park he has seen deer attracted to oak trees in which gray squirrels were nutting, by the sound of the squirrels barking. The deer had learned that the gray squirrels dropped many acorns. He says, "Several years ago there was a very heavy crop of acorns on an oak ridge. I hunted this ridge three or four different days, and as I was searching particularly for large bucks I had abundant time to watch the deer. Several times I saw feeding deer raise their heads when they heard the squirrels barking at a distance and look intently in the direction of the sound. If they saw any nuts dropping, they walked over under the tree in which the squirrel was working and ate the acorns. They had learned to associate the sound with the food."—Geo. Bird Grinnell, *New York City.*

CURIOUS PALATAL OBSTRUCTION IN MUSTELA LONGICAUDA

While collecting on the prairies north of Islay, Alberta, Canada, I took among others on October 31, 1919, a specimen of *Mustela longicauda* disclosing a rather



curious circumstance. Upon cleaning the skull I found a tough length of vegetable stalk, in diameter about the size of a knitting needle, firmly wedged in the cups formed by the rearmost and second molariform teeth. The piece fit securely

and neatly and was removed only after a surprising degree of pressure. By the depression of the palatal cartilage I judged the obstruction to have been in position for a considerable time. The animal doubtless engulfed it along with food; and by a singular chance, the piece being of precisely the right length, it caught and lodged permanently in the position as shown in the sketch. The working of the tongue against the unnatural protuberance would serve daily to force it more securely into the cups. Beyond an early and temporary irritation the animal doubtless suffered but little material disadvantage. The stalk on dissection seemed peculiarly gritty and hard as if undergoing as it were a kind of saline petrifaction. Upon examining several skulls of *longicauda* taken at the same time and place the cups or pits of the one under discussion seemed just perceptibly enlarged by the obstruction. The individual was large of frame (total length, 450 mm.; t. vert., 155; foot, 50; ♂) and in perfect physical condition.—J. Dewey Soper, *Guelph, Ont.*

ERRONEOUS IDEAS CONCERNING SKUNKS

It is commonly believed that if a skunk be picked up by the tail he is powerless to discharge his scent; it is also believed by many people that if the fluid from the scent glands reaches the eye it will cause blindness. Evidence secured during this summer seems to demonstrate that neither of these beliefs is tenable.

August 10, 1920, a member (not the writer) of a Michigan Museum of Zoology expedition working near Little Girl's Point in Gogebic County, Michigan, caught a nearly grown male skunk (*Mephitis hudsonica*) in a trap. A wire noose on a stick was slipped over the skunk's head, and after it was drawn tight and the animal partly choked, the trap was removed. The skunk, however, was not quite dead and to prevent him from getting his feet up on the noose, where he could have discharged his scent, the wire was given a slight jerk from time to time. At one of these jerks the wire broke. To keep the skunk from escaping while a new noose was being made the animal was held up by the tail. At this time he was nearly dead from the choking he had received, but he soon began to recover and suddenly without any warning he discharged a small quantity of the scent fluid into the left eye of his captor. The injured eye smarted sharply and both eyes immediately produced many tears. The eye was wiped out with a handkerchief, for there was no stream of water within a mile, and in about five minutes the smarting passed away, leaving, aside from the odor, no after effects.

I know of another case where, while a trapper was skinning a skunk, the scent fluid was accidentally discharged into the eye. The eye was well bathed in water and no permanent damage to the vision resulted.

Skunks seemingly cannot discharge the scent if held up off the ground by one foot where this has been caught in a trap. But if they can get the hind feet upon the trap which is holding a front foot the scent can be discharged. An instance of this kind happened in Gogebic County on the expedition above mentioned. If often happens, however, that a skunk which is handled slowly and cautiously in a trap can be lifted off the ground by a pole and will not discharge the scent even though three or all of his feet are on the pole. It may be possible then that a skunk might sometimes be held off the ground by the tail without disastrous results, but there is no question but that he is fully able to discharge the scent under these conditions.—Lee R. Dice, *University of Michigan, Ann Arbor, Mich.*

DATES OF SHEDDING OF ANTLERS

The data on the shedding of antlers at the National Zoological Park in the November number of the Journal of Mammalogy were of intense interest to me and I append data on same in the Philadelphia Zoological Garden for the year 1920:

Axis deer (*Cervus axis*)	March 19.
Barasingha deer (*Rucervus duvaucelii*)	April 1, 6.
Virginia deer (*Odocoileus virginianus*)	January 3; April 14.
Black-tailed deer (*Odocoileus columbianus*)	February 3.
American elk (*Cervus canadensis*)	March 27, 28.
European red deer (*Cervus elaphus*)	March 10.
Japanese deer (*Sika nippon*)	April 12; May 2, 7.
Kashmir deer (*Cervus hanglu*)	April 30.
Hog deer (*Hyelaphus porcinus*)	February 1.

—C. Emerson Brown, *Zoological Gardens, Philadelphia.*

NOTES ON NOMENCLATURE OF SOUTH AMERICAN MAMMALS

Dasypus hybridus Desmarest.—This name should be cited from Desmarest 1804 (Nouv. Dict. d'Hist. Nat., vol. 24, Tab. Meth. Mamm., p. 28, 1804) instead of from Fischer 1814 (Zoognosia, vol. 3, p. 126, 1814).

Lama guanicoe Müller.—Molina's name *Camelus huanacus* (Saggio sulla Storia Nat. del Chili, pp. 317–320, 342, 1782) for the large southern guanaco is antedated by *Camelus guanicoe* Müller (Natursyst. Suppl., p. 50, 1776). The southern form, therefore, should be known as *Lama guanicoe* and the small Peruvian guanaco described by Lönnberg (Archiv f. Zool., vol. 8, no. 19, p. 8, 1913) becomes *Lama guanicoe cacsilensis.*

Tayassu pecari Link.—Fischer's specific name *pecari* (Zoognosia, vol. 3, pp. 285–287, 1814) now commonly cited for the white-lipped peccary is antedated by *Sus pecari* Link (Beytr. z. Naturgesch., vol. 2, p. 104, 1795). The earlier reference, therefore, should be used.

Dasyprocta paraguayensis Liais.—Although provisionally and somewhat irregularly proposed (Climats, Geol., Faune du Bresil, p. 536, 1872), this name is clearly based on Azara's *Acouti.* As shown by Thomas, Azara's animal is not the one named *azaràe* by Lichtenstein but a smaller species which has been called *felicia.* This species, therefore, should take the name *paraguayensis* and *Dasyprocta felicia* Thomas (Ann. & Mag. Nat. Hist., (8), vol. 20, p. 310, 1917) becomes a synonym.

Sciurus boliviensis nom. nov.—This name is proposed as a substitute for *Macroxus leucogaster* Gray which is preoccupied by *Sciurus leucogaster* F. Cuvier 1831 (Suppl. Hist. Nat., Buffon, vol. 1, p. 300, 1831). Cuvier's name is a synonym of *Sciurus aureogaster*, which applies to a species of the subgenus *Echinosciurus*, while Gray's name stands for a species of the subgenus *Leptosciurus.* For those who regard these groups as full genera, therefore, the *leucogaster* of Gray would not be invalidated by a previous *leucogaster* belonging to a different genus. If the respective groups are regarded only as subgenera, however, action as above is required.

Sciurus gerrardi inconstans nom. nov.—This name is proposed as a substitute for *Sciurus versicolor* Thomas 1900 (Ann. & Mag. Nat. Hist., (7), vol. 6, p. 385, Oct. 1900) which is preoccupied by *Sciurus versicolor* Zimmermann 1777 (Spec. Zool. Geogr., p. 520, 1777).

Mystax ursulus Hoffmannsegg.—Although usually quoted from Humboldt or Geoffroy 1812, the name *ursula* for the black tamarin marmoset appears to have been used first by Hoffmannsegg in 1807. The citation is as follows: *Saguinus ursula* Hoffmannsegg, Mag. Gesellsch. Naturforsch. Freunde, Berlin, vol. 1, 2tes Quart., p. 101–104, Apr.–June 1807.

Cebus nigritus Goldfuss.—Buffon's *Sajou negre* (Hist. Nat. Suppl., vol. 7, p. 109, pl. 28, 1789) was given the technical name *Cercopithecus nigritus* by Goldfuss in 1809 (Vergleichende Naturbeschreibung d. Säugeth., vol. 1, p. 74, 1809). Hence the current name *Cebus cirrifera* Humboldt 1812 should be supplanted by *Cebus nigritus* Goldfuss 1809.—Wilfred H. Osgood, *Field Museum of Natural History, Chicago, Ill.*

NOTES ON THE MAMMALS OF THE LOWER YUKON REGION

The following notes refer in general to the region roughly bounded by the Yukon River from Holy Cross to Russian Mission, and by the Kuskokwim from McGrath to Bethel, 500 miles by river. They relate unless otherwise indicated to the year 1919. This region has periods when wild life is abundant. These are followed by periods of scarcity. This applies to our resident game birds as much as to mammals. For some years there has been a very notable scarcity of small mammals generally in this section. A marked increase is noticeable in the various species this winter (January, 1920) and we may look forward with confidence to a rapid increase during the next few years.

To be more particular, I will say the Canada lynx, common generally over this range in 1915 and 1916, disappeared almost entirely. The brush rabbit or varying hare is another striking example of a species which becomes excessively abundant and then disappears suddenly almost to the last one. In 1914, I often walked along the river bank near McGrath Postoffice with a gun and killed twenty or more of these hares, hanging them in bushes and leaving them for a native to pick up with a boat, as the load was often too much to carry. During the years 1915 to 1918, I do not remember to have seen one of these rabbits. The foxes also were very scarce and the few that remained seemed hungry and were not fat. Foxes in this locality get quite fat when food is plentiful, but the various species of mice also were gone, as were our resident game birds. But now we see a few lynxes returning, there are also more foxes, and rabbits are common, but not abundant, in a few localities, and there is an abundance of mice. If local conditions are a guide, then Alaska should receive more money for its furs this season than ever before in its history; and this notwithstanding the fact that two important furs, marten and beaver, are protected by law. The catch of mink this season has been large and the price very high.

Weasels also are plentiful; probably more have been taken in the Lower Yukon region than ever before. Muskrats, that were not generally considered worth shipping fifteen years ago, are now one of the most important furs of the territory. I have no statistics, but muskrat may now be our leading fur. The regu-

lations protecting the beaver and the pine marten are not very generally enforced and many of these animals will be taken this season. The territory in Alaska is very large and the money appropriated for protection of game and fur animals is very little, amounting this season to much less than the value of illegally caught furs that were seized.—A. H. Twitchell, *Flat, Iditarod Region, Alaska.*

RECENT LITERATURE

Fitzsimons, F. W. The Natural History of South Africa. Mammals. Vol. 3, pp. i–xiii, 1–278, 47 plates; Vol. 4, pp. i–xix, 1–271, 30 plates. London; Longmans, Green and Co., 1920.

The last volumes of this work, copies of which have recently reached America, are filled with interesting facts in the history of the mammals of South Africa, presented in an original and unusually readable form. The third volume, dealing with the ungulates, pictures a sad record of extermination rarely equalled in historical times in any part of the world. It is a vivid reminder of the passing of the Age of Mammals. While the solitary and smaller antelopes have held out to a surprising degree, even in settled communities, the gregarious and conspicuous species have been literally swept away since the advent of the white man. Of the bluebuck it is stated that the last known individual was killed as early as 1799 or 1800, and that only five specimens are preserved in the museums of the world. A few quaggas existed until about 1878. The typical form of Burchell's zebra is extinct, or nearly so; but one of its subspecies, threatened with the same fate, has been saved by the establishment of game reservations and by the enforcemence of strict government regulations. The beautiful bontebok, which formerly occurred in tens of thousands, is extinct in a wild state; only three or four hundred animals, some of which are mixed with blesbok blood, remain today on carefully guarded preserves. The blesbok, too, has virtually ceased to exist as a wild creature, but is said to be in no danger of extermination as it is kept in numbers on fenced farms; the meat commands a good price in the markets and there is a regular demand for specimens. The white-tailed gnu exists only under similar conditions.

The typical white rhinoceros has been reduced to about 20 individuals on the game reserves in Zululand, while possibly "one or two may exist in remote parts of southern Rhodesia," where one, supposed to be the last, was shot in 1895. The case of the elephants of the Addo Bush, practically the only survivors of the South African herds, is reviewed at some length. It has been variously estimated that these numbered from 90 to 150 animals; but 75 are now being killed under official direction, and it has been predicted that within four years the elephant will be extinct in South Africa. In spite of this harrowing detail of man's destruction of interesting creatures, the accounts of the former abundance of the gregarious species are fascinating, and particularly interesting are the stories of the early migrations of the enormous herds of springboks. The hippopotamus is known to migrate at sea between the mouths of rivers.

The fourth volume includes accounts of the insectivores, rodents, cetaceans, the elephant-seal, pangolin, and aard-vark. It is stated: "Shrews vary in their

habits in the winter in South Africa. In those districts where the winter is very cold and sharp frosts prevail, the Shrew lies dormant and bereft of the power of movement." It is in connection with his general remarks on the Soricidæ that the author makes the astonishing statement that "In Europe and other countries where the winter is very cold, and insect life exceedingly scarce, the Shrews seek out some snug, sheltered situation, and hibernate until the return of warm weather, which brings with it an abundance of insect life." Of particular interest in this volume are the chapter on the South African hedgehog and the account of the introduced North American gray squirrel. The gray squirrel is said to have become such a source of vexation to fruit growers that it has been placed on the "vermin list" at Cape Town, and a bounty has been authorized for its destruction.

—*N. Hollister.*

Dixon, Joseph. NOTES ON THE NATURAL HISTORY OF THE BUSHY-TAILED WOOD RATS OF CALIFORNIA. Univ. California Publ. Zool., vol. 21, no. 3, pp. 49–74, pls. 1–3, 3 figs. in text, December 10, 1919.

"It is the function of the present paper," writes the author, "to place on record such facts as have been learned to date in regard to the habits and associational relationships of the bushy-tailed wood rats occurring in California." Following adequate descriptions of the two Californian forms (*Neotoma cinerea cinerea* and *N. c. occidentalis*) the status of the fossil form *Teonoma spelaea* Sinclair from Potter Creek Cave is considered, the author confirming Kellogg's reference of it to the recent *N. c. occidentalis.* The species *cinerea* is boreal in distribution, its altitudinal range being from 5,000 feet, as in Kings River Canyon, to 13,090 feet, on the summit of Mount Lyell.

The life history is taken up under 13 headings, as follows: local associations, mannerisms and behavior, timidity and reflexes, tracks and other sign, houses, hibernation, breeding season, growth of young, relation to other animals, foraging, food, population, and economic status. Of particular interest is a comparative statement of the relative speed of nervous impulses in individual wood rats and certain other small rodents based on shutter-speed necessary to stop all motion when the animals were photographed. $\frac{1}{25}$ second stopped motion in the bushy-tailed wood rat; $\frac{1}{50}$ second, alpine chipmunk (*Eutamias alpinus*); $\frac{1}{25}$ second, California pocket gopher (*Thomomys bottæ*), Great Basin pocket mouse (*Perognathus parvus olivaceus*), Tahoe chipmunk (*Eutamias speciosus frater*), and Nelson antelope ground squirrel (*Ammospermophilus nelsoni*); $\frac{1}{10}$ second, California ground squirrel (*Citellus beecheyi*).

—*Walter P. Taylor.*

ADAMS, CHAS. C., GEORGE P. BURNS, T. L. HANKINSON, BARRINGTON MOORE, AND NORMAN TAYLOR. Plants and animals of Mount Marcy, New York. Ecology, vol. 1, 1920: part 1, pp. 71–94, (April) August; part 2; pp. 204–233, (July) October; part 3, pp. 274–288, (October) November. (Contains remarks upon the ecological distribution of mammals on Mount Marcy.)

ANDERSON, MALCOLM PLAYFAIR. The discovery of the Chinese takin. Nat. Hist., vol. 20, pp. 428–433. September–October, 1920.

ANDREWS, LORING. A chamois hunt in Switzerland. Forest and Stream, vol. 90, pp. 231–233. May, 1920.

ANDREWS, ROY CHAPMAN. In Mongolia and North China. Nat. Hist., vol. 20, pp. 356–373. September–October, 1920. (Some experiences in collecting mammals on the American Museum Asiatic Expedition.)

BANNON, ARTHUR H. A bear hunt on the Clearwater. Forest and Stream, vol. 90, pp. 103–106, 144, 146. March, 1920. (Experiences along one of the tributaries of the Stikine River in British Columbia.)

BANNON, HENRY. The game ranges of Klappan. Forest and Stream, vol. 90, pp. 485–487, 513–518. September, 1920. (Account of the hunting grounds south of the Stikine River in British Columbia.)

——— Caribou and moose in Klappan. Forest and Stream, vol. 90, pp. 629–631, 660, 661. December, 1920. (Hunting in the Cassiar district, northern British Columbia.)

BARBER, W. E. Commission's state-wide hearings. Wisconsin Conservationist, vol. 2, no. 4, p. 5. September, 1920. (Summary of hearings upon methods of protecting the muskrat, mink, and deer from possible extermination in Wisconsin.)

BARNABY, W. C. Whitetail deer in New Hampshire. Forest and Stream, vol. 90, pp. 581–584, 612–614. November, 1920.

BELITZ, A. F. On the trail of the white-tail. Wisconsin Conservationist, vol. 1, no. 5, p. 1, November, 1919; no. 6, pp. 5, 6, January, 1920; vol. 2, no. 1, pp. 33, 34, March, 1920; no. 3, pp. 7, 8, July, 1920. (An attempt, based upon imaginary grounds and rather illogical reasoning, to prove that the original habitat of the white-tailed deer was in Wisconsin. Uses the name *Cariacus wisconsinensis* for the Wisconsin white-tailed deer, l.c., vol. 1, no. 5, p. 1, November 15, 1919.)

BLAIR, W. REID. Notes on the birth of a chimpanzee. Zool. Soc. Bull., vol. 23, pp. 104–111. September, 1920. (A young chimpanzee, born in the gardens of the New York Zoological Society, lived for eight days.)

BROWN, W. S. Doe with three fawns. California Fish and Game, vol. 6, no. 1, p. 37. January, 1920. (Observed in the Lava Bed section of the Modoc National Forest, August, 1919.)

BROWNLOW, O. P. Where do deer sleep? California Fish and Game, vol. 6, no. 2, p. 88. April, 1920. (Mule deer in southern Sierras stated to bed within thick cedars or other forest trees on moonlight nights, and in more open spaces during the dark of the moon.)

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mals; definition, relationships, history, evolution, distribution, anatomy, and classification. Closes with a full page table showing the author's views on the classification of the families and higher groups.)

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——— Report on the mammals collected by Mr. Edmund Heller during the Peruvian expedition of 1915 under the auspices of Yale University and the National Geographic Society. Proc. U. S. Nat. Museum, vol. 58, pp. 217–249, pls. 14–15. 1920. (Lists 65 species, of which one, *Holochilus incarum,* from Santa Ana, is new.)

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Washington Park Zoological Society. Tenth annual report; Milwaukee, Wisconsin. 1920. (The Milwaukee zoological gardens collection of mammals includes 102 specimens of 66 species.)

CORRESPONDENCE

CENSUS OF PRIVATE MAMMAL COLLECTIONS

Editor Journal of Mammalogy:

There is an undeniable scarcity of private mammal collections in this country, and it seems to me that the Journal, as well as the active members of the Society, should endeavor to increase the interest along this line. For one thing, it is conceded that the enthusiasm of most earnest workers in zoology was first stimulated by starting "a collection." Those of us who are not so fortunate as to be located near some large museum must, to a great extent, depend upon our private collections as a basis for any systematic work which we wish to do. If a person desires to work on a certain genus or order, it is advisable to secure, by exchange or purchase, specimens from different parts of the country, but he will usually find it difficult to get in touch with other collectors who are in a position to furnish the material desired.

With these facts in view, I suggest that a census be taken of the private mammal collections of North America, and a summary of the information gathered could then be published in the Journal. If this plan meets with your approval, I should be only too willing to act as compiler. The value of such a list depends upon its completeness, so *everyone* with a private collection of mammals, even though it be but a small one, should send in full information as to its size, territory covered, special interests, et cetera.

Yours truly,
A. B. Howell.

268 S. Orange Grove Ave.,
Pasadena, California.

SUBSCRIPTIONS RECEIVED TOWARD THE PUBLICATION OF "THE COMPARATIVE OSTEOLOGY OF THE PROCYONIDÆ"

Editor Journal of Mammalogy:

My letter published in the Journal of Mammalogy (Vol. 1, No. 4, August, 1920) on the question of raising the funds to publish the above mentioned work needs no comment. The amount to be raised will be somewhere between $1000 and $1300, and the following sums have been either pledged or sent for the purpose.

1.	The Elizabeth Thompson Fund of Harvard University	$200.00
2.	George T. Welch, M.D., Passaic, New Jersey	6.00
3.	H. J. Boldt, M.D., New York City, N. Y	2.00
4.	A. B. Howell, Esqr., Pasadena, California	2.00
5.	Mrs. Anna Botsford Comstock, Ithaca, New York	2.00
6.	E. Gordon Alexander, Esqr., Lexington, Mo	2.00
7.	Prof. Glover M. Allen	2.00
8.	E. B. Trescott, Petaluma, Cal	2.00
9.	Prof. Davidson Black, Peking, China	4.00
10.	Dr. H. H. T. Jackson, Washington, D. C	2.00

Very truly,
R. W. Shufeldt.

EDITORIAL COMMENT

The third annual stated meeting of the American Society of Mammalogists will be held at the United States National Museum, Washington, D. C., May 2 to 4, 1921. This is by far the most pleasant season of the year for a visit to Washington. The complete success of the second annual meeting in New York last spring makes it certain that there will be a large attendance, and a full and interesting program, with added social features, is expected. Announcements giving full particulars will be mailed by the corresponding secretary to all members.

From the suggestions for change of style for the Journal of Mammalogy made by members of the Society during the past year, four plans have been approved by the committee on publications. These are: (1) Whenever possible the descriptions of illustrations shall appear as legends under the plates instead of in a special "explanation of plates." (2) Author's address shall be printed after each regular article or general note. (3) In listing titles under "Recent Literature," instead of repeating author's name, when there are two or more titles, use a long dash. (4) Print brief reports of the activities of Sections of the American Society of Mammalogists, signed by the secretaries of such sections.

A full and ready response should be made to Mr. A. B. Howell's request, in the correspondence department of this issue of the Journal, for information regarding the private collections of mammals in North America. The statistics gathered by such a census will furnish valuable and interesting data. Let every member of the Society and reader of the Journal who has a study collection of mammal skins and skulls, no matter how small or how local it may be, write to Mr. Howell at once. The editor would suggest that the census be not restricted to private collections, but include all collections in universities, museums, and public institutions as well. The more information that is given regarding the extent and scope of each collection the more useful will Mr. Howell's final report be to all, and most of the members of the Society will be interested in knowing something of the size of our larger American collections, as well as what regions they particularly cover.

Many libraries nowadays bind scientific serial publications with all the covers in place. Those who do much work with bound volumes of journals appreciate the many advantages of this system and always encourage its use. The colored covers of heavier paper help one to find the initial page of the number or part one wishes to cite, and they make more readily accessible the date of publication of any particular page. It was a common practice at one time to destroy the original covers when the parts were assembled for binding, and in many an old volume the lack of these covers is now a distinct loss. The later idea of binding the covers at the back was a step in the right direction, and the modern idea of leaving each brochure intact, exactly as received, is a still greater improvement. With this idea in mind the Journal of Mammalogy will issue the title page for each volume as a separate sheet, to be mailed with the first number of the succeeding volume. The index for the entire year will be printed in its proper place

in the last issue, and there will be no necessity to mutilate any number when the volume is sent to the binder.

It may be argued that the danger of loss of the separate title page is a disadvantage, but it is believed that the chances of this are small, and after all the lack of the title page in a bound volume would not be a serious matter. It would be far outweighed by the knowledge that each separate number is in the exact form as received from the publisher, and that each plate and page is in its right place. One advantage in having the title page mailed with the first number of the succeeding volume, rather than with the last number of the volume with which it belongs, is that the actual date of publication of each number may be listed in it. This advantage of having the exact date of publication of each page readily obtainable in a uniform place in each bound volume will be appreciated by those using library sets of the Journal in the years to come.

—N. H.

Vol. 2 MAY, 1921 No. 2

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BANDING BATS

By A. A. Allen, Ph.D.

[*Plates 4–5*]

The interesting article by Mr. A. B. Howell on "Some California Experiences with Bat Roosts" in the August number (1920) of the Journal inspires me to put on record a few observations that I have made on the bats in central New York, and a recent attempt that I have been making to mark individual bats with the aluminum bands of the American Bird Banding Association.

Seven species of bats are known to occur at Ithaca, New York, five of which are common and widespread. The hoary bat, *Nycteris cinerea,* is known only as a migratory species from a few specimens taken during October, and the Say's bat, *Myotis subulatus,* has been found but twice, July 2, 1904, and June 11, 1914. Of the others, the large brown bat, *Eptesicus fuscus,* and the small brown bat, *Myotis lucifugus,* are abundant about buildings, the latter being the more common. The other three, *Nycteris borealis,* the red bat, *Lasionycteris noctivagans,* the silvery-haired bat, and *Pipistrellus subflavus,* the pipistrelle bat, usually roost about trees or in crannies in the rocky sides of the gorges. The pipistrelles, however, frequently assemble in dark corners of buildings along the edges of the ravines.

The only ones I have found roosting in colonies are the little brown and the pipistrelle, the former occurring during the breeding season in colonies often of several hundreds, in dark attics, cupolas, etc., while the latter usually roost in small clusters. The accompanying photograph shows a cluster of 18, the largest I have seen.

On June 24, 1916, a neighbor, Mrs. Willard Austen, living close to Fall Creek gorge, informed me that some bats had been roosting in a

dark corner of her porch for some time and were making a nuisance of themselves by soiling the floor. She wished me to do away with them. Upon examination I found four female pipistrelles hanging in the darkest corner of the ceiling of the porch, which was partially shut in, in their characteristic tight cluster. Mrs. Austen informed me that they had been there the previous summer and that efforts to dislodge them by turning the hose on them, and poking them with brooms, were only temporarily successful, as they always returned the next night. This interested me and I wished to determine whether it was always the same bats that came back in spite of the disturbance or whether this porch was a roosting place known to many bats. Accordingly I ascended to their retreat and picked them off without their making any effort to fly. It was at this time I discovered that they were females carrying large embryos and I surmised that they had come here to have their young. I then took four of the smallest size bands of the American Bird Banding Association and placed them on their legs, taking care not to close them completely, but pinching them on tightly enough so that they would not come off. I then carried the bats three blocks to my home where after observing them for a time, I released them.

Mrs. Austen promised to inform me if the bats returned but as I never heard from her, the incident was forgotten until three years later, June 29, 1919, when she telephoned me that the bats had again been annoying her. She had invited a small boy to shoot them and when they picked up the dead bats they found the aluminum bands on their legs. I secured the bats of which there were again four, and three of them bore the bands that I had put on three years before. The numbers were 15899, 15901, 15902. Number 15900 had either been lost from the leg or else the bat had disappeared and its place been taken by another. The fourth bat was a female and all again were carrying large embryos. I inquired of Mrs. Austen whether the bats had been roosting on the porch during the two preceding summers but as she had been away each summer she was unable to inform me.

This curious incident of the same three, and probably the same four bats, staying together or returning to each other after three years had elapsed, reminded me of how little we know of their habits. Again, Mr. Howell, in his suggestive account of the California bats, states his belief that most of our bats are migratory, but the very fact that we cannot state so definitely shows how little we know about them. He speaks, for instance, of the large brown bat, *Eptesicus fuscus fuscus*,

as absent or very rare during winter in California, but with us it is the only species for which we have definite winter records. On several occasions I have seen them flying about in the day time during February or March, and, nearly every winter in January or February, one comes out of hiding and flies about the halls of the Zoology building at Cornell University. All these facts point to the need for further study of these interesting little beasts. The valuable results that are now being obtained by banding birds could no doubt be duplicated with bats if only enough persons would coöperate in the project of banding.

Illustrating the ease with which the banding can be done when the opportunity offers, I discovered this year a cluster of pipistrelles clinging to the gable of my barn; holding an insect net beneath them, I touched one of them with a stick and instantly the whole eighteen dropped into the net. This was on June 5 and I observed that sixteen of the number were females heavy with young. (The pipistrelles, in this locality, normally bear two young.) Each of these bats was banded as described above and liberated. Most of them returned to the barn sooner or later as the size of the cluster seemed to be about the same a few days later. They cling so closely to one another that it is impossible to count them and, at this time, close observation of them was made impractical by their roosting beside a large hornets' nest. Between the first and the middle of July, apparently, the young were brought forth but it was impossible to tell exactly. On the night of the fifteenth, however, two of the young were large enough to be left alone, for when I scanned the gable with the aid of a flash light, I discovered them hanging where the whole cluster had been during the day. On the twenty-fifth of the month the pipistrelles had moved away from the hornets' nest and the young seemed to be of good size so I again held the net beneath the cluster. This time I did not hold it quite so carefully and two of the old bats escaped. Ten adults and sixteen young were captured, however, and of these nine of the adults bore the bands that had been placed upon them the fifth of June. The bands were somewhat scratched, probably by the bats' teeth, but the skin showed no signs of abrasion by the bands. All the young but one could fly, and they were much darker and grayer than their parents. Nine were females and seven were males. If each of the twelve females had had two young and there were but sixteen left, it bespeaks a rather high mortality, doubtless at the stage when they were learning to fly. The young were banded and all were released. After that time there

was a cluster of varying size in the barn up to the last of August but by September first they had dispersed or found another roosting place. It will be interesting to learn if they come back next year, if exactly the same ones keep together, and if the young return with them or, if their numbers are not augmented by the young, as was the case with the four banded in 1916. Whether the pipistrelle migrates or hibernates I am unable to say from my own observations. They appear in the spring about the first of May about the time that the migratory silvery-haired bats appear, and I have seen them as late as the first of November.

While on the subject of bats I should like to describe a breeding colony of the small brown bat, *Myotis lucifugus*, which I examined a number of years ago, July 5, 1907. It was in the attic of a house in Homer, New York, 22 miles from Ithaca. The house was of brick with a flat tin roof sloping toward one end, the attic ranging from 18 inches to four feet in height. At the lower end of the roof the tin had become loosened from the brick, causing a crack of from half an inch to an inch in width through which the bats gained entrance. The bats congregated at the lower end of the attic hanging head downward from the roof trusses in large mats. They did not, however, cling to one another or form such dense clusters as do the pipistrelles. These masses were composed chiefly of adult females and young nearly grown. In one place where the roof was scarcely 18 inches from the floor, a large cuboidal space had been formed in the brick wall owing to the rotting away of a large joist. Here large numbers of the oldest young had congregated with a few females carrying young. The place most populous with bats, however, and the place where probably all of the young were born, was the space above the brick wall and below the roof between the trusses. Here the pregnant females had gathered in large numbers. From one of these spaces, thirty females were removed, all with small young or large embryos. Of course there was no pretense of a nest, the young being brought forth on the bare bricks. These were moist with urine but the excrement was apparently all ejected onto the floor where it had accumulated in piles several inches deep.

No female containing more than one embryo was found although some of the females were accompanied by two young of very different sizes. In fact there seemed to be three distinct sizes of young in the attic of which from thirty-two to thirty-six of each size were secured. The smallest had apparently been born but a short time. Of these four-

FIG. 1. ONE OF THE FEMALE PIPISTRELLES, SHOWING ATTACHMENT OF THE BAND. JUNE 5, 1920

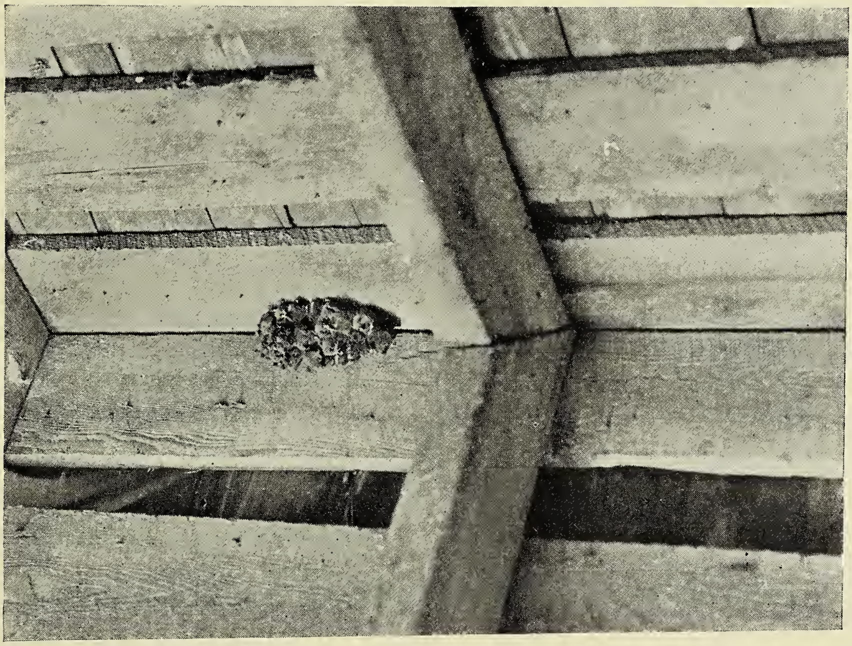

FIG. 2. A CLUSTER OF EIGHTEEN PIPISTRELLES HANGING TO THE GABLE OF THE BARN. JUNE 5, 1920
These bats were captured and banded

FIG. 1. LARGE BROWN BAT (*Eptesicus fuscus*) WITH A BED BUG (*Cimex pilosellus*) BEHIND EACH EAR

A flashlight photograph taken immediately after the capture of the bat, before the bugs had moved.

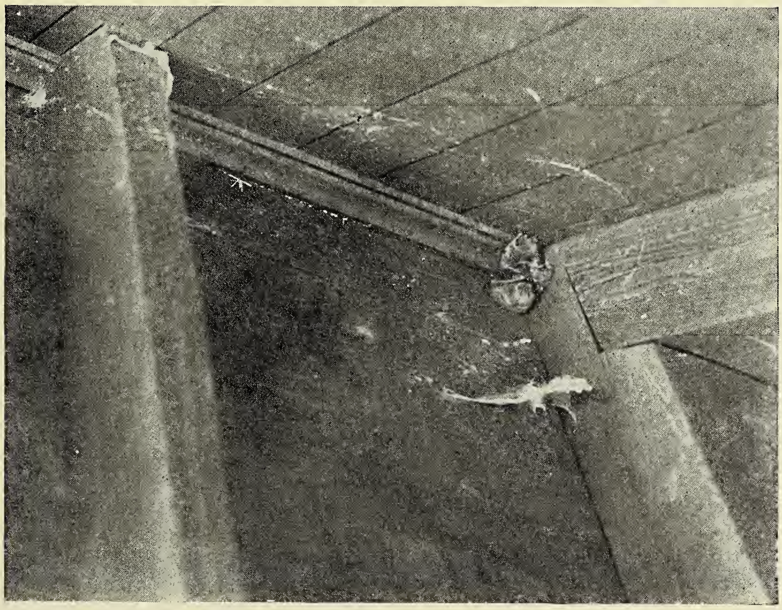

FIG. 2. A CLUSTER OF FOUR FEMALE PIPISTRELLES HANGING TO THE CEILING OF A PORCH

These bats were banded June 24, 1916, and three of them were found in the same place June 29, 1919.

teen were males and nineteen were females, averaging 52.5 mm. in length. They had very black skin, almost naked, what hair they had being pale brown. The second size, of which there were twenty-one males and fifteen females, averaged 60.8 mm. in length. They wore a thin covering of hair, more sparse on the venter, more buffy in color than that of the adults. The third size, of which there were thirteen males and nineteen females, averaged 72.8 mm. in length. They were fully haired, the color being much darker than that of the adults.

A few females were found accompanied by two young of the smallest and largest sizes and a few others that contained embryos were accompanied by medium-sized young which seemed to be nursing, indicating the possibility of more than one litter in a season. There is a bare possibility that in the confusion resulting from my disturbance some of the young might have become frightened and clung to the wrong mother. I am inclined to the belief, however, that this species never has but a single young at a birth and that it has two litters a season. The red bat, the silvery-haired bat, and the pipistrelle, on the other hand, normally bring forth two young and have but one litter.

I did not succeed in capturing all of the bats in this roost as there were many crevices from which I could not force them. In all, however, I secured 101 young and 135 adults. Of these 48 of the young were males but only four of the adults were males, indicating that while the sexes are normally of about equal number, they segregate during the season of gestation and care of the young. The presence of a few males may indicate that the males rejoin their mates for a short time between litters.

There is a popular superstition that bats carry bedbugs and during my stay in the attic I had plenty of opportunity to verify this belief as well as that they have innumerable fleas and mites. I made quite a collection from the bodies of the bats but unfortunately they were lost in transit and never identified. I have since, however, taken specimens from the large brown bat, *Eptesicus fuscus,* a photograph of which accompanies this article, which were identified for me by Mr. Van Duzee as *Cimex pilosellus* Horvarth, a species which never seems to infest man. I can supplement this statement by the fact that though I was in the attic for nearly two hours and saw them crawling all around, I received no bites, and careful examination of my clothes failed to reveal a single specimen.

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THE PRESENT STATUS OF THE EUROPEAN BISON OR WISENT

By Theodor G. Ahrens

Originally there existed two types or species of wild oxen in Europe: The ur (urus), auerochs, Slavonic tur = *Bos primigenius;* and the wisent, Polish zubr, Roumanian zimbr = *Bos bonasus* L. or *Bison europaeus.*

The ur had no mane, resembled our domestic cattle, but had larger horns. The wisent has a mane, long hair on neck and shoulders, a hump, short horns and is a counterpart of our American bison. The ur became extinct in Europe, with the exception of Russia and Poland, in the fourteenth and fifteenth centuries.

Aristotle mentions the wisent in his history of animals with the title of "bonasos"; Pliny, Calpurnius Siculus, and Seneca describe it, referring to the Paeonian species. Pausanias and Dio Cassius (150–235 A.D.) speak of the wisents as "Paeonian bulls." Wisents and urs lived in Switzerland in the middle ages, but became extinct in France before 1400. The wisent is mentioned in Sweden in the eleventh century and wisent hunts are described in the Vilkina-saga, written in the thirteenth and fourteenth centuries. The wisent may have existed in England in the twelfth century, if certain references in the literature of the time may be believed, but the so-called "Wildwith cattle" in Chillingham Park and other herds of half-wild cattle in private estates are presumably descendants of the ur.

A classic mention of both species of wild cattle is to be found in the Nibelungenlied, the celebrated middle high German epic. Here the exploits of Siegfried, the principal hero of the poem, during a hunt in the Odenwald are described:

> Dar nach sluoc er sciere einen wisent und einen elch,
> Starker ure viere. . . . .
> (After which he slew quickly a wisent and an elk, four powerful urs . . . .)

It should be mentioned that the words "auerochs" and "ur" have caused much confusion. These expressions were generally used for the wisent after the extinction of the ur in Germany. The word "wisent" was forgotten and did not come again into use until 1850, but has been generally used again since 1880. As "auerochs" was the official name for wisent—bison—zubr (Polish for wisent) from 1450 to 1850, we may be pretty sure that when "auerochs" is used in the literature of this

period, "wisent" is meant; but Baron Herberstein, who was German ambassador in Russia from 1516 to 1518, has correctly distinguished the two animals and illustrated them in his book "Moscoviter wunderbare Historien" (Wonderful Moscovite tales), calling the auerochs "auerox" and wisent "bisont."

The province of East Prussia, which belonged since 1511 to the Hohenzollerns, harbored a very considerable number of wisents. Many wisent hunts are mentioned in literature, and the animals enjoyed considerable protection. In 1726, 117 wisents were still counted, but in 1755 the last animal in East Prussia was killed by a poacher. In Brandenburg the wisent existed till the eighteenth century. It was carefully protected and in 1743 eleven were still accounted for. In 1768 the last Brandenburg wisent perished.

Wisents lived in Austria and Hungary throughout the middle ages, but became extinct there in the sixteenth century.

Finally the forest of Bieloviesh (Russian), Bialowies (German) or Bialowicza (Polish), in Lithuania near Grodno, and a district in the Caucasus Mountains are or were the only remaining regions in which any considerable numbers of indigenous wisents lived. To be sure, upon the estates of the Prince of Pless in southeastern Upper Silesia, and in Ascania Nova in southern Tauria (north of Crimea), belonging to the recently deceased F. von Falz-Fein, a small number were maintained, but these animals had been imported and were not indigenous.

The great forest of Bieloviesh had been a royal hunting preserve since the eleventh century and wisents could only be hunted there by special permission from the ruling dynasty. The Polish-Saxon kings protected the wisents and ceased to allow any economic use of the forest. After the dismemberment of Poland, the Russian czars continued this policy of protection so that up to our own times the forest remained a carefully protected sanctuary.

To give some idea of the hunts which took place in Bieloviesh under Polish rule, we learn that at one hunt, in 1744, 30 wisents were killed; 42 in 1752, and at the latter 1000 peasants were forced to act as beaters to drive the game together.

Since 1820 the czars prohibited the cutting down of trees and serious efforts were made to protect game in general, and wisents in particular. In 1860 the first imperial hunt took place. Two thousand peasants acted as beaters; many foreign princes and a great number of persons of all ranks were present. Twenty-eight wisents and much other game were killed. In 1897, 37 wisents were killed at an imperial hunt; in 1900, 45.

In 1828 Brincken remarks that: "à la fin de la dernière guerre le nombre des Bisons s' était diminué jusqu' à se réduire à 300."

Nevertheless in 1826 from 700 to 800 were counted; in 1829, 711; in 1830, 772; but in 1831, probably in consequence of revolutionary movements, 657 only. For the next fifty years this average must have been maintained; for in 1884–1885, 500, and in 1891, 479, were quoted. Thereupon a ukase of the 3/15 February, 1892, gave absolute protection to the wisents for all time, so that at the beginning of the present century more than 1200 are mentioned. In the following years severe epidemics broke out, so that only 727 remained in 1914. The war was naturally disastrous, so that when the German administration of the forest started, scarcely 160 remained. Since this event the wisents were counted every month as far as possible, and in March, 1917, the count showed 121, consisting of 18 old and 18 young bulls, 30 old and 36 young cows, and 19 calves. In 1918, after 30 square kilometers of the forest had been reserved as a natural sanctuary, the herd seems to have increased to 170 or 180 head.

The German efforts to protect the wisent began in March, 1915, when Professor Conwentz, head of the "Staatliche Stelle für Naturdenkmalpflege in Preussen" (Prussian Bureau for the Protection of Nature) called the attention of several army commanders in the East to the endangering of the wisent. The ninth army therefore caused a strict prohibition of wisent shooting to be issued, and on October 1, 1915, Captain (later Major) Escherich, a Bavarian Forstrat (forest commissioner), was appointed commander and head of the German forest administration of the occupied district.

Owing to the energetic efforts of this active and experienced forest official complete protection of the remainder of the wisent herd in this extensive forest, the inaccessible recesses of which rendered any control extremely difficult, was finally carried through.

As early as September 25, 1915, a ruling regarding hunting was issued by Lieutenant-General von Seckendorff, which declared: "We desire to preserve the Wisent herds as far as possible, although this is enemy territory, so as to convey to posterity a Natural Monument of peculiar value." Thus the best hopes for the future were entertained, but then came the collapse of the German power and the revolution of November, 1918. On December 16, 1918, shortly after the revolution, Major Escherich wrote to the "Staatliche Stelle": "In consequence of the events of the past weeks the military forest administration can no longer exercise any control over the protection of game in the forest

of Bialowies and consequently the Wisent herd of 170–180 head is seriously reduced. The imminent retreat of the German troops increases considerably the danger of extermination of the animals and thus extinction of the species is to be feared." In fact it seems that all or nearly all the remaining wisents have been shot by the inhabitants and the retiring German soldiers, among whom discipline had been undermined by the revolution. Notwithstanding, Professor Matschie of Berlin, who is well acquainted with the territory, told me that in his opinion it is very possible that wisents may still exist in impenetrable thickets of the forest. Unfortunately, there has been no corroboration of this view.

About the end of the seventeenth century the first news of wisents in the Caucasus reached Europe. Since then little was known of the species till Professor Filatow made three trips to the district between 1909 and 1911 for the express purpose of studying the animals. The Caucasian wisent varies but slightly from the type in Bieloviesh; the shape of the skull and the horns, which resemble those of the American bison, being the chief peculiarities. It is known as *Bos* (*Bison*) *bonasus caucasius* Grevé. At one time the Caucasian wisent lived in the district of Mount Elbrus, but its territory has been reduced to a comparatively small area in the Kuban region in northwestern Caucasia. Cutting down of the forests was the chief cause for the diminution. The last known area, where Caucasian wisents lived is as follows: Its northern limit is south of the towns of Atschcha and Atscheschbok, then along the bend of the Umschten and Schischa Rivers to the mouth of the Besymjanka, and somewhat south at the mouth of the Maltschepa. The whole area is 50 versts between east and west and 20 versts between north and south. According to Filatow, the number of animals was "scarcely less than 100, but under no conditions as many as 1000." Since the revolution the Kuban cossacks have demanded the return to them of these hunting grounds, which had been leased by them to the Grand Duke Sergius Michaelowitsch who endeavored to protect the wisents there, and thus an extermination of the species is also to be feared. Professor Matschie thinks that the remaining Caucasian wisents have abandoned their old range and emigrated to other regions, at present unknown.

The herd of Pless above mentioned was founded in 1864 or 1865, when a bull and three or four cows were presented to Prince Pless by Czar Alexander II. and the former placed them in his extensive estates in southwestern Upper Silesia. The animals increased there consid-

erably. In 1893, 5 more cows were introduced from Bieloviesh. In 1918 there were about 60 animals there, but according to Professor Pax of Breslau the animals in Pless have been severely decimated since the German revolution and total extermination is to be feared at the hands of poachers.

The present war between Poland and the Bolsheviki has again passed over the Bieloviesh region, continuous disturbances are taking place in the Caucasus, and Upper Silesia is in perpetual unrest because of the differences and antipathies between Poles and Germans. Besides the wisents still extant in Pless, and possibly in Ascania Nova, there remain a few specimens in zoological gardens. But, if we sum up, we must nevertheless conclude that the extinction of the species is imminent.

There exists a very extensive literature upon the wisent, of which a few works may be quoted:

1. Baron de Brincken: Mémoire descriptif sur la Forêt Impériale de Bialowicza en Lithuanie. Varsovie, 1828.
2. von Jarocki, Felix Paul: Zubr oder der lithauische Auerochse. Hamburg, 1830.
2. Eichwald, E.: Naturhistorische Skizzen von Lithauen, Volhynien und Podolien. Wilna, 1830.
4. Büchner, Eugen: Das allmähliche Aussterben des Wisents im Forste von Bjelowjeska. St. Petersburg, 1895.
5. Bialowies in deutscher Verwaltung. Herausgegeben von der Militärforstverwaltung Bialowies. 1 und 2 Heft, 1917. 3 und 4 Heft, 1918. 5 Heft, 1919. Berlin.

Besides countless articles and essays in hunting periodicals, in the literature appertaining to the protection of nature, etc.

Landauerstrasse 4, Berlin Wilmersdorf, Germany.

CAPTURING SMALL MAMMALS FOR STUDY

By Vernon Bailey

As we look backward the field study of mammals seems a comparatively recent development in North American mammalogy. Briefly, the published works of Richardson in 1829, Audubon and Bachman in 1845, Baird in 1857, Coues and Allen in 1877, and Merriam in 1884 mark the development of mammal study in this country. Among these Baird was the pioneer in the formation of a North American collection of mammals, but the fact that satisfactory methods of collecting and preserving small mammals had not been devised, prevented the accumulation of series of specimens meeting the demands of modern methods of study. It remained for Doctor Merriam and his associates to develop the science along these lines, and under his guidance the large series of specimens which laid the foundation of our present knowledge of the mammals of North America were brought together. The methods of collecting were gradually standardized and improved until today we have many museums stocked with well-prepared and carefully labeled specimens. Intensive collecting should be continued until the gaps in our museum series are filled, and every college, normal school and high school has its collection of local species.

The series of mammal specimens in the Biological Survey collection have now reached such proportions that along certain lines of collecting we are slowing up. The present policy of the survey is to collect fewer and only choice specimens except in special cases or in unworked areas. This affords what many of us have long felt the need of, more time for a closer study of life-histories.

The recent outlines for field study of life-histories by Seton, Nelson, Taylor, and Anderson are steps in the right direction. These are mere outlines, however, and while rich in suggestions they need to be amplified for the benefit of beginners.

The first question that arises is where and how to find something to collect or study. Take the abundant and easy things first. One can find plenty of meadow mice and white-footed mice almost anywhere outside of city limits. Go into the meadows, old fields, or grassy fence rows, get down on your knees, part the grass, and you will probably find little trails or runways over the surface of the ground. Their appearance, bits of cut grass stems, and other signs of occupation generally tell you if the mice are there. Or go into the woods or to a rocky slope and look under logs, in hollow trees, under stones, in little

caves and niches of the cliffs and ledges for tracks or traces of white-footed or red-backed mice, or for tiny burrows and runways of shrews, or for larger burrows and hollows where chipmunks live. Or go into the woods and find the homes of flying squirrels by pounding on the sides of hollow trees or trees with old woodpecker holes in them, and watch the flying squirrels peep out and in response to harder pounding soar away to other trees. Listen for the chatter of red or pine squirrels and then steal up quietly and watch them at work or play and get their home range located so that you can come and watch them at any time. Learn how to find the common species and you will gradually learn to find the rare ones.

The next step is to get the animals you want for specimens or to catch them alive for closer study. If you wish specimens, set any of the half dozen kinds of snap traps that come down across the necks or backs and kill quickly, selecting the right sizes for the animals you are trapping. In runways set the trap across the run so the trigger will be in the way of passing mice, and sprinkle rolled oats over it. For white-footed mice and others that do not make runways place the traps where they feed or travel and sprinkle plenty of rolled oats over the trigger and a little around the trap. For chipmunks and flying squirrels use larger traps, generally the size made for rats, set on logs or stumps or in hollow trees or little shelves on the sides of trees, and baited with nuts or bread fastened to the trigger and sprinkled over with rolled oats. For shrews set mouse-size traps under logs or rocks or banks or at little burrows in woods earth, with a bit of fresh meat or bacon on the trigger and also a sprinkle of rolled oats. A great variety of baits may be used, grains, seeds, nuts, bread, meat, and vegetables according to the tastes of the animals, but rolled oats seem to appeal to the greatest number. There are several pamphlets giving directions for preparing specimens.

While catching animals for specimens is a very necessary and fundamental part of our study, the process does not teach us much of their habits. Catching them alive for study is just as easy. Forty years ago I had to make all of my traps for small mammals and most of the traps caught the animals alive and uninjured.

The simplest trap is the inverted bowl. A glass bowl is good but a tin can, pan, bucket, or box will do. A light dish or box may need a stone on top for weight. Cut out of a thin board or shingle a trigger, rounded at one end and pointed at the other. Fasten some bait to the pointed end and place the rounded end under the edge of the bowl or

box and the baited end about the middle underneath. The mouse wiggles the bait and the bowl drops over him. You slide a paper, tin or bag under the bowl and pick up your mouse and place him in a bag

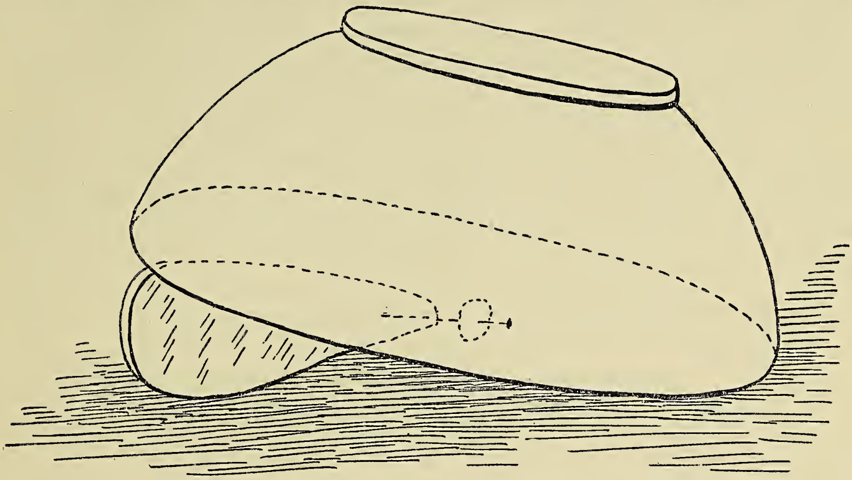

FIG. 1. BOWL TRAP FOR CATCHING MICE ALIVE

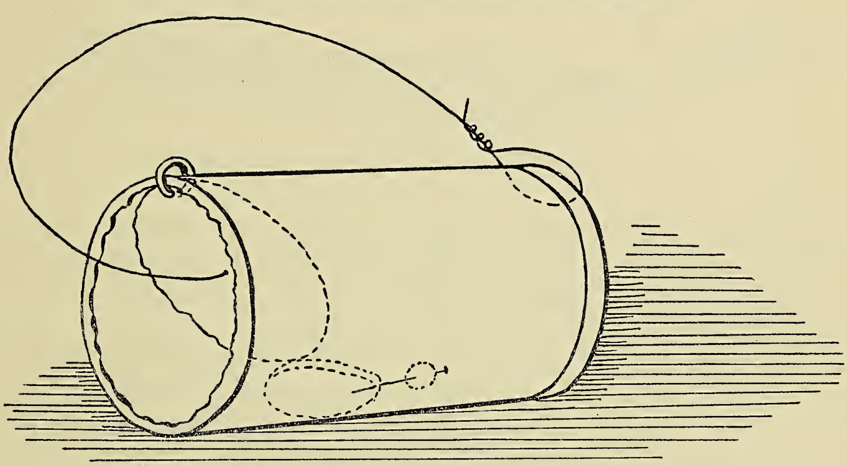

FIG. 2. TIN CAN TRAP FOR CAPTURING MICE ALIVE

or box or cage. Some food and nest material may be placed inside the trap if the weather is cold or you cannot come back soon to examine the trap.

A tin can makes a good live trap. Cut a piece of tin to fit inside of the open end. Hinge it with a wire loop at one edge so it swings in

and not out. Fasten a springy wire along the outside and attach to the lid so that it is drawn shut. Push the lid in and place a baited spindle under its lower edge to hold it open until the mouse wiggles the bait. Then the spindle drops and the door snaps shut with the mouse inside. A still simpler trap may be made by cutting a hole in one end of a tin box and placing a sloping hinged door inside that easily lifts up for the mouse to enter and drops down behind him.

The regular figure-four trap or one of the various forms of rabbit traps may be made of tin or boards for animals of larger size up to woodchucks and raccoons. In fact much of our fur could be taken in such traps with less cruelty and less injury to the fur than in steel traps.

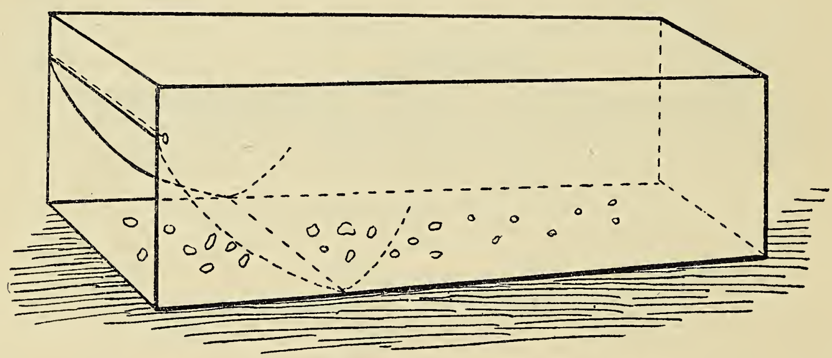

Fig. 3. Tin Box Trap for Capturing Mice Alive

Deep holes in the ground near the burrows or runways of some species of mice and shrews will catch the animals, but other kinds will not fall into them. Many mice may be caught in your hands if you know where to find them under the haycocks and grain shocks when the grain and hay are being hauled. With a little practice you can catch any mice that are uncovered in the field and hold them so they will not bite you. By following the tracks of white-footed mice on the snow to their underground winter dens you can easily dig down and catch them in your hands. I have caught as many as four at a nest in this way. With a light pick and shovel you can dig out many burrowing species and in doing so learn much of their habits, homes, nests, young and food, besides catching the animals alive for study.

The next thing is how and where to keep your menagerie. Simple wire screen cages with wooden or tin bottoms and ends and sliding

doors are easily made and prove the most satisfactory of any I have tried. These can be kept on a table in your library where you can watch the animals, play with them in your spare moments, and learn much of their habits in captivity that you will never learn in the field. It is a fascinating study. I have had a pocket gopher, a meadow mouse, six white-footed mice of three species, and four pocket mice on a table in my library all winter and am finding out new habits every few days—new at least to me.

The little pocket mice are especially gentle and easily handled. With their silky coats and quiet ways they are the favorites with the children who love to hold and play with them. The white-footed mice are still too nervous and sensitive to be handled much and it may take a second generation to make them sufficiently domestic for good pets. They are the most beautiful, graceful, and animated of the lot.

The meadow mouse has more individuality than I ever credited it with. A female in my collection is not afraid, but objects to being handled or petted, and will bite if caught and held. She will sit in my hand and run over my arms and clothes, but prefers her independence. She is quick and skillful but cautious. For over six weeks her cage door stood open and she ran over the table and among the cages as she pleased but never fell or jumped off. Then the cages were moved so she got onto the window sill and down to the floor and she soon learned to get down, even if she had to jump.

The pocket gopher has undergone the most surprising reformation. Instead of trying to eat me up as he did at first he often begs me to take him up out of his box of earth and will climb into my hand and scratch my arm and pull at my sleeve, and is happiest when I hold him and stroke his glossy coat. He is too full of energy to be quiet for long, and soon wants to get down to run round and round the room or out in the yard where he can burrow in the ground, or in his barrel of earth where he digs furiously by the hour. We have to be careful not to touch him until he knows who is there, for he does not see well and when surprised his first impulse is to bite whatever comes within reach. But even the children have learned to play with him safely and have great fun watching him dig in the ground and push out loads of earth, and fill his capacious cheek pouches with food.

All of these animals were caught when practically full grown and it has taken a long time to get them gentle. Still there are advantages in studying their habits which had become fixed and natural in the wild state. There will be other advantages in studying young raised in captivity as they will be free from any restraint or nervous tension.

All of the mice are interested in little "ferris wheels" in which they spin and ride by the hour, getting their exercise and much evident enjoyment from them. Even the little pocket mice, usually so quiet, become enthusiastic, spinning their wheel.

We have learned much that is new to us of their habits, dispositions, tastes, voices, calls, signals, hours of work and play, sleep, nest-building, sanitation and general home-making. Their time and manner of molt have been carefully noted. Their breeding habits are still to be studied. The only trouble is for busy people to get time enough to watch them, but there are many who need just such occupation and would greatly enjoy it. I hope to see a large number of people started in this kind of study, the results of which will be far-reaching in practical knowledge of our numerous species of small mammals.

Biological Survey, Washington, D. C.

THE MAMMALS OF ITASCA COUNTY, MINNESOTA

By Alvin R. Cahn

Itasca County, one of the largest of the Minnesota counties, lies in the north central part of the state, Koochiching County intervening between it and the Canadian boundary. Sparsely settled, with few cities of any size, the county retains a considerable variety of primitive qualities, though lumbering years ago and frequent forest fires have done much to ruin an otherwise ideal environment. A myriad of lakes, countless small streams and sphagnum bogs, hemmed in and surrounded by pine woods, however, still shelter and protect an abundance of animal life.

Yet this county, like so many of the unsettled regions of the north, is doomed in the not far distant future to undergo great changes. Further lumbering, clearing of land, homesteading, and road building will open up what is now almost inaccessible territory, and these developments will of course exert great influence upon the wild life of the region. The transition from the primitive conditions of the woods to their present state has led to the total extinction of several mammals, and to the reduction of others almost to the point of extermination. Further change will stamp out these latter and greatly reduce other species.

It seemed advisable, when the opportunity presented itself, to investigate the vertebrate fauna of this region before further changes occurred. This chance came to the writer during the last half of July and in August, 1919. During this period much of the county was covered, and the results of that portion of the investigation relating to mammals are herewith presented. A report on the avifauna of the county has been published elsewhere.[1]

The data upon which this paper is based are from two sources: personal investigation, and information furnished the writer by Mr. George Dwigans, a woodsman who has spent years within the county, and who is perfectly familiar with its big game. The investigation was made possible through the kindnesses of Dr. Sydney Kuh, who has a cabin in the heart of the county, and to him the writer expresses his appreciation.

A list of the mammals of Itasca County follows.

1. Northern Virginia Deer. *Odocoileus americanus borealis* Miller.—Still reasonably common throughout the county. The great areas available for its habitation—including a considerable amount of forest and game preserve—together with the scanty settlement of large sections of the county are conducive to the welfare of the species. In spite of the fact that the deer are relatively undisturbed during most of the year, they are shy and suspicious as compared with those found in northern Michigan and Wisconsin. However, during the early summer, deer visited the vegetable garden near the cabin almost nightly, as disclosed next morning by the tracks in the soft earth. On the morning of August 1, Doctor Kuh and Mr. Jacobsen surprised a doe and two fawns on the road near Lawrence Lake (Prairie River) and their automobile came within a few inches of running one down.

2. Moose. *Alces americanus* Jardine.—Rapidly nearing extinction in Itasca County, and very seldom seen. The species is probably more of a migrant from the country to the north and west than a permanent resident within the county. During the early summer—June, 1919—the tracks of a large sized moose were found one morning traversing Doctor Kuh's garden on Lake Minnewanka, an incident which has occurred several times during previous years. Doctor Kuh has the mounted head of a bull which was killed during the hunting season in 1911. If the moose is to be saved anywhere outside of forest and game preserves, it is high time that it be protected to the full power of the law. The moose is about to be added to the list of animals that *formerly* inhabited the county, to which list already belong the caribou, elk, fisher and marten.

3. Canada Lynx. *Lynx canadensis canadensis* Kerr.—Because of its secretive habits, the lynx is very seldom seen. It occurs, however, throughout the county, and is quite often taken by trappers during the winter months. During August,

[1] Cahn, A. R., Bird Notes from Itasca County, Minnesota. Wilson Bull., vol. 32, no. 4, pp. 103–122. December, 1920.

1917, Mr. Dwigans and party "spotted" a fine specimen on Lake Elizabeth. Confused by the light, the lynx permitted the canoe to approach within ten feet. The animal was on the ground, and had evidently come to the lake to drink.

4. Wild Cat. *Lynx rufus rufus* (Güldenstædt).—The writer has, unfortunately, little information to offer regarding this species. It occurs sporadically throughout the county, but in no considerable numbers.

5. Domestic Cat. *Felis catus* Linn.—Included in this list because there are a great many "house" cats that have taken to the woods, where they spend all their time. These animals are self-sufficient; they are essentially wild, as they can not be approached, and are dependent entirely upon their own wits and skill for their subsistence.

6. Timber Wolf. *Canis nubilus* Say.—Still fairly common within the county, but greatly reduced in numbers over former years. Although it is heard occasionally, the timber wolf is rarely seen during the summer. During the winter, however, so Mr. Dwigans tells me, it is frequently seen in clearings and crossing the frozen lakes. As the species travels considerably in winter, it is altogether likely that there is an influx of wolves during the cold weather.

7. Brush Wolf. *Canis latrans* Say.—This smaller wolf—never, by the way, called "coyote" in the north woods— is considerably more common than its larger relative, and is distributed throughout the county. Seldom seen in the summer, but heard by the writer during the night on many occasions.

8. Red Fox. *Vulpes fulva* (Desmarest).—The red fox, once rather common in Itasca County, must now be considered rare. The writer found no evidence of its presence, but during the last few years Mr. Dwigans has taken several very fine specimens within the territory under discussion. Of the color phases of the red fox, two have been taken: the cross fox, and the silver fox. As these phases are considered by the natives to be distinct species, a word regarding them may not be out of place. The silver or black form is the dark phase of the red fox; the cross fox is intermediate between the red and the silver. Both are, then, merely individual color phases of the red fox. "In a litter of fox cubs born of red parents, perhaps there may be a silver. On the other hand, one or more of the cubs of a silver vixen are quite certain to be red."[2] Under domestication this tendency of silvers to throw red cubs can be overcome by selective and careful breeding.

9. Northern Black Bear. *Ursus americanus americanus* Pallas.—Very nearly extinct in Itasca County. Those individuals that remain are so wary that they are very seldom seen. However, tracks and signs are met with occasionally, and no doubt the forest preserves and the more inaccessible places still hold their occasional bear. Although the black bear is by all odds the most common, the cinnamon phase is not unknown. Doctor Kuh has a very beautiful pelt of a brown bear taken near his cabin a few years ago. The black bear is another of the mammals that will not long survive within the county unless rigidly protected.

10. Racoon. *Procyon lotor lotor* (Linn.).—Somewhat more common in Itasca County than the following species, but still a rare animal in the county, being

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[2] Dearborn, Ned, The Domesticated Silver Fox. Farmers Bull. no. 795, U. S. Dept. of Agr., p. 4, March, 1917.

seen and taken only occasionally. Doctor Kuh has the skins of several racoons taken in the vicinity of Lake Minnewanka, and all are typical in size, color and markings.

11. Badger. *Taxidea taxus taxus* (Schreber).—The badger must now be considered very rare in Itasca County, and is rapidly approaching extinction in this area. Once not uncommon, it is now almost unknown. At Ely the writer found a skin of this animal that was taken within Itasca County during October of 1918, but the exact locality—other than that it came from the northwestern section—could not be ascertained. Mr. Dwigans has taken the animal several times in the county.

12. Canadian Otter. *Lutra canadensis canadensis* (Schreber).—Common throughout the county, and steadily and rapidly increasing in numbers. Along the shores of Beaver Lake "otter runs" were in evidence. Several individuals were seen in Lake Minnewanka during the writer's stay, and on the shore of Rice Lake five old signs were found, all being 100 per cent crayfish remains. With the otter as common as it is in Itasca County, it would not be amiss to open the trapping season for two years. If opened, however, the situation should be carefully watched by the game warden department and by competent observers, and closed again at the end of that period if conditions warrant.

13. Mink. *Mustela vison letifera* Hollister.—Common throughout the county, frequenting the lakes and rivers, where it feeds largely upon crayfish, frogs and some of the smaller shore fishes. Successfully trapped during the open season; the fur is of high grade both in quality and in color.

14. Least Weasel. *Mustela rixosa rixosa* (Bangs).—This little weasel (length about 6½ inches), easily recgonized by the absence of the black tip on the tail, is relatively common in spots, and is apparently local in distribution. Two individuals were seen on August 14 near Cedar Lake.

15. Short-tailed Weasel. *Mustela cicognanii cicognanii* Bonaparte.—Considsiderably larger than the preceding (length about 12 inches), this weasel is told at a glance by the always present black tip of the tail. Several skins were seen at Ely, and one live individual was seen on July 30 at Lake Minnewanka. It seems possible that the long-tailed weasel (*Mustela longicauda spadix* Bangs) may occur occasionally, though this area probably is about the northern limit of the species. The writer was told that occasionally a much larger weasel, with a black tipped tail, is taken, which may well be this larger species.

16. Skunk. *Mephitis hudsonica* (Richardson).—Abundant throughout the county, and often in evidence. During the summer of 1919, one of these animals insisted on living under the cabin floor, much to the joy of Bubbles, the family "badger dog," who persisted in his endeavors to dig it out. These performances were unsuccessful in many ways, and were unpleasant particularly because Bubbles usually became interested about meal time. Every evening after dark the skunk wandered down to the garbage dump, and we could hear him rattling around for several hours. It is interesting to note that the dominant form is the "full stripe," and Mr. Dwigans assures me that he has not had any "black" specimens among the many skunks which he has taken.

17. Minnesota Varying Hare. *Lepus americanus phæonotus* Allen.—The only rabbit of which the writer could get any trace was the big "white rabbit" or "snow-shoe." This interesting form is common, and was seen frequently during

rambles through the woods, and along the roadside when traveling by machine at night. Some species of cotton-tail is present, but no specimen was procurable for identification.

18. Red-Squirrel. *Sciurus hudsonicus hudsonicus* (Erxleben).—Common everywhere in the woods and about the towns. The oak trees furnish the chief item of food for the species, though the hazelnut (*Corylus* sp.) is common enough to be of some use. Young were seen playing about the nest on July 21.

19. Lake Superior Chipmunk. *Eutamias quadrivittatus neglectus* (Allen).—Two species of chipmunks are found within the county, of which this is the more common. Found everywhere through the wooded areas where it feeds upon any available nuts. Unlike the next species, this little fellow shows a marked inclination to climb.

20. Gray Chipmunk. *Tamias striatus griseus* Mearns.—Quite common throughout the county, both in the hardwood and evergreen thickets. Found co-existent with the preceding species, and both seem to show a preference for the hardwoods. This species shows a decided preference for the ground, and is seldom found "up a stump." Food consists of berries and nuts. Called the "gray" chipmunk because of the gray tinge of the upper parts.

21. Gopher. *Citellus tridecemlineatus* (Mitchill).—Rare in the cleared lands, but found occasionally in the cultivated areas about the towns and farms. This county probably represents about the northern and eastern limit of the species in the state.

22. Woodchuck. *Marmota monax canadensis* (Erxleben).—Quite common throughout the county and often seen, either in the clearings or along the roads. A woodchuck took up his residence under the cabin floor, but departed hurriedly when the family—and Bubbles—arrived. This hole was quickly—and permanently—occupied by the afore-mentioned skunk.

23. Flying Squirrel. *Glaucomys sabrinus sabrinus* (Shaw). The flying squirrels are always very little in evidence, and unless special search is made their presence would never be suspected. This species is relatively common throughout the county, both in the woods and about the homesteads and towns.

24. Porcupine. *Erethizon dorsatum dorsatum* (Linn.).—Common throughout the county in all suitable places, yet not nearly as common as the writer found the species either in northern Wisconsin or in northern Michigan. This is, of course, not to be regretted, for the animal does a large amount of damage. Prefers the hardwood thickets, and feeds largely on the top-most branches of the ash (*Fraxinus americanus*) and the aspen (*Populus tremuloides*). Along the lake shores it feeds upon the succulent stems and roots of the arrow-heads (*Sagittaria* sps.) and the white water lily (*Castalia odorata*).

25. Beaver. *Castor canadensis michiganensis* Bailey.—Very nearly exterminated within the county limits. The writer saw but a single colony, apparently healthy and in a thriving condition, on Beaver Lake. The house here was of good size, and of the shore-line type, with the entrance in about eighteen inches of water. Evidence of activity was found in well worn log-shoots, and in a small ash (*Fraxinus americanus*) cut the night before. Until a year ago (the fall of 1918) there was a colony of two small houses in Rat Creek, between Little and Big Rat Lakes. Here a dam had been built, which seriously damaged fourteen tons of good hay belonging to a homesteader. Now the beaver—and

a part of the dam—are gone: the conclusions are obvious. There is another colony, which the writer did not visit, on McCabe Lake, just north of Beaver Lake, and so far as the data go, these are the only two colonies in the county.

26. Muskrat. *Ondatra zibethica zibethica* (Linn.).—Common throughout the county wherever there are suitable conditions, but surprisingly little in evidence as compared with northern Wisconsin and northern Michigan. Seen swimming in Lake Minnewanka, in Cedar, and Rice Lakes, as well as in many of the small unnamed lakes, and heard splashing almost every night. Several houses were seen, though none was of considerable size.

27. Meadow Mouse. *Microtus pennsylvanicus* (Ord).—Abundant throughout the county, and seen usually as a dark moving object in the leafy underbrush. The species is more active at night than in the day time. An individual of the species was seen crawling about on a pile of drifting wood in the locks where the Mississippi River leaves Lake Winnibigoshish. Evidence of damage to young fruit trees was common in new orchards.

28. Norway Rat. *Rattus norvegicus* (Erxleben).—Found commonly about the homesteads and in the towns, and probably quite local in distribution. However, it mysteriously appears upon the scene shortly after a house is built, probably being transported with the lumber or boxes.

29. House Mouse. *Mus musculus* Linn.—Common about the homesteads and in the towns.

30. Northern Deer Mouse. *Peromyscus maniculatus gracilis* (LeConte).—This beautiful rodent is very common throughout the county, and is frequently seen both in the woods and about the houses, in which it makes itself perfectly at home. Gets into the food supply, but does no serious damage.

31. Jumping Mouse. *Zapus hudsonius* (Zimm.).—The writer is unable to offer any information as to the abundance of this species in the county, but its occurrence is undoubted. A skin found at Ely was taken within the county in July, 1917, and the presence of the species is known generally to those familiar with the smaller animals of the region.

32. Short-tailed Shrew. *Blarina brevicauda brevicauda* (Say).—Seen by the writer only once; little information can be offered at the present time as to the abundance of the species.

33. Common Shrew. *Sorex personatus personatus* St. Hilaire.—A single specimen of this little shrew was found in the woods under a pile of cut logs, near Lake Minnewanka, on August 12. The animal measured 84 mm., and the stomach contents were entirely cricket remains.

34. Richardson's Shrew. *Sorex richardsoni* Bach.—Two shrews of this species were found, one dead near the cabin, and another brought in by Bubbles. They measured 110.5 mm. and 114 mm. respectively.

35. Marsh Shrew. *Neosorex palustris* (Rich.).—This, the largest of the shrews found, is recorded from a single specimen caught in a swamp near Cedar Lake, and from another seen at Balsam Lake. The former measured 151.5 mm.

36. Say's Bat. *Myotis subulatus subulatus* (Say).—This bat is very common everywhere in the county, and is found both in the woods and around the homesteads.

37. Little Brown Bat. *Myotis lucifugus lucifugus* (LeConte).—One of these bats was taken and two more seen, all near camp on Lake Minnewanka. The

two were seen almost every evening, beginning their twilight excursions about seven o'clock.

38. Red Bat. *Nycteris borealis borealis* (Müller).—Several were seen on August 8, between Bovey and camp. The stomach of one examined contained unidentifiable insect remains, mostly Diptera.

EXTERMINATED MAMMALS

The following species of mammals are known to have existed in Itasca County within the last fifteen or twenty years, but the writer is unable to offer any data whatsoever that would indicate that they are at present to be found therein.

1. Woodland Caribou. *Rangifer caribou sylvestris* (Rich.).—Formerly present, though it is doubtful if the type of country is such as to have attracted the species in any great numbers. Reported by Herrick[3] from the St. Louis River (which is in St. Louis County) a few miles east of Itasca County.

2. American Elk. *Cervus canadensis canadensis* Erxleben.—Never really common in Itasca County, owing to the fact that it is a forested country. Reported by Herrick[4] as common from Lake Itasca (in Clearwater County, about 35 miles west of Itasca County) in 1885. There are no records of either species within the last fifteen years.

3. Marten. *Martes americana americana* (Turton).—Disappeared, apparently, soon after the caribou and elk. It is possible that an occasional marten may still be caught as a wanderer from another part of the coniferous area.

4. Fisher. *Martes pennanti pennanti* (Erxleben).—The most recent of the exterminated mammals, and there is a bare possibility that it may still exist, though the writer can find no recent records of its presence. Like the marten, probably a wanderer from adjacent territory.

Texas Agricultural & Mechanical College, College Station, Texas.

[3] Herrick, C. L., Mammals of Minnesota. Geol. & Nat. Hist. Surv. of Minn., Bull. 7, 1892, p. 277.

[4] Herrick, C. L., ibid., p. 280.

DESERT AND LAVA-DWELLING MICE, AND THE PROBLEM OF PROTECTIVE COLORATION IN MAMMALS

By Francis B. Sumner

[*Plate 6*]

The prevailing tendency of desert animals—particularly the mammals, birds and reptiles—to assume a buff or pallid hue is a phenomenon which has long attracted the attention of naturalists. In many cases these colors harmonize strikingly with those of the bare sand and gravel, as well as with the commonly parched and stunted vegetation amid which such animals dwell. Oftentimes the creature need only come to rest in order to disappear from view, its presence becoming evident only when running or flying is resumed.

At a first glance it would seem perfectly evident that we here have to do with the well-known phenomenon of concealing coloration. This, we might suppose, has been acquired by these various creatures through the process of natural selection. The vegetable feeders among them have become more and more invisible to their carnivorous pursuers, while the latter have profited in being concealed from their prey. It is commonly assumed by those who hold this view that the color variations which are selected for survival are quite random in their origin, at least to the extent that they are not influenced in any direct way by the environment.

Various facts make it evident that this explanation is quite inadequate in the case at hand. I will mention but a few of the more obvious objections here. Later, I shall discuss certain special lines of evidence, based upon my own field and laboratory observations.

(1) Most desert rodents are strictly nocturnal in their habits. (This, admittedly, is not a conclusive argument, since the moonlight of the desert is brilliantly clear, and it is probable that owls, at least, among the predators, are largely guided in their search for prey by sight.)

(2) One group of these rodents—the pocket gophers—spend practically their whole time beneath the ground. Nevertheless, strikingly pale species are to be found in certain desert regions. (Here again, it must be admitted that carnivorous animals, both birds and mammals, lay a heavy toll upon the gophers, catching them frequently when they are half emerged from their holes.)

(3) The process of depigmentation applies to parts of the body which are not exposed to view. For example, the soles of the feet of

desert deer-mice are nearly or quite lacking in pigment, while those of mice from the more humid coastal regions vary from purplish to nearly black. Again, the fur of the ventral surface of the body is whiter, in desert forms, owing to the relatively greater length of the terminal unpigmented zone of the individual hairs. Akin to this is the fact that the ventral white area of the pelage tends to extend higher upon the sides of the body, a circumstance which would seem to render the animal more, rather than less conspicuous.

(4) The dorsal white stripes of the skunk are broader in the desert races.[1] It has rarely been contended that the skunk owes its peculiar fur pattern to the need for concealment. The class of facts cited in the last two paragraphs seems to indicate that depigmentation, rather than concealing coloration *per se*, is the thing which results from life in arid regions.

(5) I shall offer evidence below which tends to show that the need for concealing coloration on the part of these rodents has been greatly overestimated.

The general correlation between depth of pigmentation and atmospheric humidity is, of course, a widely recognized fact. Not only may we contrast the pale desert races with their dark relatives from the humid coast belt of the northwest, but various intermediate stations may be chosen, whose birds and mammals display intermediate shades in their feathers and fur.[1a] This principle is not, of course, one of universal application, the correlation in respect to color-tone being very imperfect. Nevertheless, the phenomenon is so widespread and so well known that I need not even cite specific cases in the present discussion.

Now the hypothesis of concealing coloration through natural selection might doubtless be advanced with a certain degree of plausibility to cover this entire situation. It could be pointed out that regions with more humid climates (at least those having a higher rainfall) have darker (appearing) soils than the less humid ones, and that therefore the effective correlation may be between pigmentation and soil color, rather than between pigmentation and humidity *per se*. But the fact that outside of the desert regions the ground, in a state of nature, is commonly covered by vegetation renders such an argument very unconvincing. Green grass is doubtless somewhat darker than dry

[1] See Grinnell (Univ. of California Pub. Zool., vol. 12, p. 257).

[1a] Instances of this tendency among mice are discussed in papers by the present writer, in the American Naturalist (April–May, 1918,) and the Journal of Experimental Zoölogy (April 5, 1920).

grass, but a seal brown mouse would probably be no better concealed in the former than in the latter.

We come now to cases in which narrowly localized races have been described, that are said to harmonize more or less strikingly with some special habitat, in respect to color-tone, and to differ noticeably from their near kin in regions closely adjacent. In some of these cases, at least, the argument that the responsible agent has been optical, rather than atmospheric, assumes a higher degree of plausibility.

Several writers have recorded the existence of very pale races of wild mice upon isolated beaches or sandy islands along the coast.[2] In a previous paper,[3] I have analyzed one of these cases rather carefully. I there dealt with a paler sub-race of *Peromyscus maniculatus rubidus*, inhabiting a practically isolated sandy peninsula on the northern California coast. Through the use of an accurate method of color determination,[4] I am now able to indicate the relative shades of the skins from the peninsula and from the redwood forests of the mainland across Humboldt Bay. The proportion of black in the two cases is 89.0 per cent for the former and 90.9 for the latter. These figures are based upon 21 and 29 mature skins respectively. The difference (1.9 per cent) is not great, but it is about 12 times its probable error ($\pm$0.16) and therefore cannot be accidental. Furthermore, it is to be remarked that all but one of the peninsula mice show less than 90 per cent of black; while all but three of the redwood mice show more than 90 per cent. Indeed, the difference between the two series is quite evident to the eye, even upon casual inspection.[5]

[2] For instance, Bangs (see Osgood, North American Fauna, No. 28, 1909, p. 121) described such a race from the island of Monomoy on the Massachusetts coast. See, also, interesting recent accounts by G. M. Allen and by A. H. Howell (Journ. Mamm., November, 1920).

[3] American Naturalist, March, 1917; Osgood (Revision of the Genus Peromyscus, p. 66) had already referred to the case in question.

[4] Flat skins, prepared according to a uniform method, and cleaned in benzine, are subjected to color analysis by means of the Hess-Ives Tint Photometer. In the present paper, the figures given represent the average tone of an area of the pelage, 24 mm. wide by 17 long (the dimensions of the visible field) and lying symmetrically, near the posterior end of the dorsal surface. One great advantage of the instrument used is that the area under analysis is rendered perfectly homogeneous and is thus strictly comparable with another homogeneous field which serves as the standard. Later I hope to discuss the use of this instrument in the study of mammalian pelages.

[5] If we consider the percentages of white, rather than of black, we have 9.2 and 8.0 respectively for the two series. This makes the difference 15 per cent of the lesser number. A much smaller increase in the proportion of white upon a color-wheel is very evident to the eye.

I have already reported[6] that these differences appear to be hereditary. Unfortunately, only three specimens of the peninsula stock have been reared at La Jolla, but all of these are paler than the palest of the redwood stock, reared at the same time, and under identical conditions. The mean percentage of black in the three skins is 88.3.

This case may be seized upon in support of the protective coloration hypothesis, but I am still disposed to adopt the view expressed in the paper cited (1917, p. 180): ". . . . it seems more likely that the pale coloration of these mice stands in some more direct relation to the humidity of their immediate surroundings." Referring to the latter, I stated (p. 179): "Despite the nearness to the ocean and the high atmospheric humidity, the peninsula region seems dry in comparison with the redwood forests. This is due in part to the loose, sandy character of the soil—where, indeed, any real soil exists—and to the comparative lack of shelter from the prevailing westerly winds. Evaporation here is doubtless more rapid than in the comparatively stagnant air of the forests." I might have added that the humidity of their subterranean abodes, in which these mice are reared and spend the greater part of their existence, is almost certainly lower in the sandy region.

The case which has chiefly prompted the publication of the present paper is that of the alleged effect of black lava in darkening the pelage of certain rodents and other animals which make it their habitat.

In his well-known "Results of a Biological Survey of the San Francisco Mountain Region and Desert of the Little Colorado, Arizona,"[7] Dr. C. Hart Merriam mentions four different animals which were captured in the lava fields of this district, and which differed strikingly in color from their nearest relatives in the neighboring desert regions. These animals are (using revised nomenclature):

Citellus spilosoma obsidianus
Onychomys leucogaster fuliginosus
Perognathus flavus fuliginosus
Phrynosoma hernandesi

The first, a squirrel, was described as a new subspecies, the second (a true mouse) and the third (a pocket mouse) as new species. The last (a "horned toad") is referred to by Doctor Stejneger, who reported

[6] American Naturalist, March, 1917, June–July, 1918.

[7] U. S. Department of Agriculture. North American Fauna, No. 3. Washington, 1890.

upon the reptiles, as "a melanistic form."[8] In each case, considerable stress is laid upon the dark coloration of the lava-dwelling forms, it being more than once stated that we have to do with "protective coloration."

It may seem to be worse than reckless for one who has neither seen the specimens nor visited the locality under consideration to call in question such circumstantial statements by an eminent naturalist. It should not be necessary for me to explain, however, that the only point at issue is the interpretation of Doctor Merriam's findings. In view of the wholly negative results of my own investigations, to be described shortly, I think that I need offer no apology for questioning whether some interpretation alternative to that adopted by Doctor Merriam is not possible here.

Two such alternatives suggest themselves. The first of these is that the color correspondences observed were due to accident. Mice of the same species and subspecies are known to vary widely in color, pale and dark specimens being trapped in the same neighborhood. One may readily form premature conclusions from an insufficient number of specimens, owing to "errors of random sampling." In the present case, it is to be noted that the first of the four named species was represented in Doctor Merriam's collections by two specimens, the second by five (two being listed as "somewhat intermediate"), the third by a single specimen, and the last by two. Moreover, several of the specimens (including the single *Perognathus*) are listed as "immature," a circumstance which raises the question whether the darker shade of the pelage was not due, in part at least, to this fact.

One would naturally lay less stress upon this first alternative explanation, particularly since Mr. Vernon Bailey (as he informs me) is able to corroborate from his own observation these impressions regarding the darker pelage of certain rodents of the region in question.

A second possibility seems to be more worthy of consideration. It is to be noted that in the case of the mammals, at least, the darker race was taken in the "piñon and cedar belt," while the paler race, with

[8] It must be insisted that the case of the reptiles is quite different from that of the mammals in respect to adaptive coloration. Some lizards, as is well known, have chromatophores which are under the direct control of the nervous system, and are therefore capable of fairly rapid color adjustments. It may well be that many other species possess this power to a less striking degree. On the other hand, it would hardly be claimed that mammalian hair is subject to such influences.

which it was compared, came from the Desert of the Little Colorado. Now it is evident from both the maps and the text of the report, that the former region occupies a considerably higher altitude than the latter, there being an average difference of more than a thousand feet between the two. Indeed they are assigned to different life zones. While no meteorological records are accessible to me, it seems very probable that the precipitation in this belt of piñons and junipers on the mountain slopes is considerably greater than on the desert plains below. Are we, then, justified in eliminating humidity as the responsible factor in bringing about the color differences in these two localities? Or is it not, indeed, possible that some unknown third factor is the one chiefly concerned?

Certain other opinions regarding the effect of lava in determining the colors of rodents should be referred to before leaving this discussion. W. H. Osgood, in his valuable "Revision of the Mice of the American Genus Peromyscus"[9] tells us (page 16) that "if the range of a given form includes a few square miles of lava beds, specimens from that area show an appreciably darker color than the normal form occupying the surrounding region." Again (p. 70) "in northeastern California, the mice of the semidesert lava beds are more like the dark *gambeli* than the pale *sonoriensis*. Throughout the desert region *sonoriensis* is the prevailing form, except on the lava beds."

It is unfortunate that more specific instances are not given in support of these statements. We should like to know more of the rainfall, vegetation, etc., of these lava beds of northeastern California; likewise (and this is vitally important) their distance from regions in which true *gambeli* is abundant. Some of Osgood's other statements (pp. 16, 70) regarding the effects of narrowly localized environmental differences, apparently in the absence of any form of isolation, are not supported by the experience of various other collectors. They must, I think, merely voice impressions based upon accidental coincidences. The careful experiments of H. H. Collins (not yet published) show that the more marked color differences, occurring in a given locality within the range of a single subspecies, are hereditary and not due to any immediate environmental influence.

Goldman[10] has recorded observations similar to those of Osgood. Of one wood-rat, *Neotoma intermedia desertorum*, he writes (p. 77):

[9] U. S. Department of Agriculture. North American Fauna. No. 28. Washington, 1909.

[10] Revision of the Wood Rats of the Genus Neotoma. U. S. Department of Agriculture, North American Fauna, No. 31. Washington, 1910.

"Specimens taken in lava beds are usually darker than those inhabiting lighter-colored rock formations." Similar statements are made in respect to other species on pages 81 and 102. Unfortunately, we have no record of the number of individuals on which these statements are based, save that in the case of *N. lepida stephensi* but a single specimen was recorded from the lava beds. We likewise have no information as to the altitude, meteorological conditions, etc., of the particular lava fields where the species in question were trapped.

The chief direct evidence which I have to offer on the present subject was obtained during a collecting trip undertaken in the spring of 1920. The choice of locality was due primarily to the suggestions of Prof. Joseph Grinnell, director of the University of California Museum of Vertebrate Zoology. Doctor Grinnell, succeeded by Mr. Richard Hunt, of the same museum, together with the writer, constituted the field party.

The lava field on which the mice were trapped lies in the Mojave Desert some 12 miles west of the village of Ludlow, and just south of the main line of the Santa Fe Railway. Unfortunately, no Geological Survey or other reliable map of this region exists. The outline of the field is very irregular, the greatest length being perhaps five miles and the greatest width three.

Regarding the age of this eruption I can learn nothing definite. The lava, throughout much of the area, looks extremely fresh, and a beautifully preserved cinder-cone ("Mt. Pisgah") occurs near the northern border. On the other hand, there are, so far as I know, no hot springs, fumaroles or other evidences of recent volcanic activity in this part of the desert. Whether the age of the field is to be reckoned in hundreds or in thousands of years I am unable to learn from the geologists whom I have consulted.

The surface of this lava bed is raised well above the general level of the desert. It is extremely rugged and difficult of passage, being crossed in every direction by jagged ridges and yawning fissures. Sand has drifted in from the surrounding desert and become deposited in cracks and depressions, affording soil for the support of scattered shrubs and annuals, even a mile or more from the nearest border. Despite the presence of occasional sand pockets of considerable extent, the prevailing tone of the lava field is extremely dark. Viewed from neighboring hilltops it everywhere stands in extreme contrast to the pale sand and gravel which surrounds it on every side. Furthermore, it must be emphasized that the mice are not confined to the small

areas of pale sand, but appear to wander freely over the barest and blackest masses of lava rock, in which positions they were frequently trapped.

Preliminary trapping revealed the fact that there were several species of mice on this field. By far the most frequent was *Peromyscus crinitus stephensi*, but *P. maniculatus sonoriensis* and two species of *Perognathus* were met with.

Circumstances pointed to the first of the foregoing species as being best adapted for the test which I had in view. As is well known, this mouse shares the prevailing buff or sandy hue so characteristic of desert rodents. Furthermore, it has one very great advantage for present purposes, namely, that it is restricted in its habitat to rocky regions, in the crevices of which it finds its shelter. Here, then, we seemed to have the conditions favorable for a crucial natural experiment. This rather extensive lava field was surrounded on all sides by areas of sand and fine gravel. Trapping, undertaken to test this point, revealed the fact that the *crinitus* mice rarely, if ever, left the lava beds and strayed for any distance into the open desert. Live-traps, which I set for 175 "trap nights"[11] upon the desert areas adjacent to the lava field yielded but two specimens of *crinitus*, both of these within 150 feet of the lava. Furthermore, Mr. Hunt, during two weeks' use of spring traps in this region, did not catch a single specimen of this species away from the lava beds. In contrast to these negative results, it must be pointed out (1) that large numbers of mice of other species were taken in these sandy areas, and (2) that *crinitus* was extremely common throughout the lava field, where it predominated over all other small rodents. It would seem likely that for centuries, and perhaps for a vastly greater period, this colony of *Peromyscus crinitus stephensi* had been isolated by fairly rigid barriers from other mice of the same species.[11a] Since the statements of Merriam, Osgood and Goldman, cited above, relate to species and to localities concerning which no such claim of isolation is advanced, it would seem that in

[11] This useful unit of trapping activity is due to Grinnell (An Account of the Mammals and Birds of the Lower Colorado Valley, University of California Publications in Zoology Vol. 12, 1914, p. 92).

[11a] Doctor Grinnell suggests that "periodic eruptions" of these mice, due to over-population, might carry them, from time to time, across these barriers. I can only reply (1) that we have no knowledge of such migrations here; (2) that such a diffusion process is at least as likely to occur in those localities where a darkening effect of lava has been alleged.

the present case, if anywhere, the darkening effect of the lava would manifest itself.

Five hundred and thirteen trap nights on the lava field yielded me 157 specimens of *crinitus*, along with 23 specimens of mice of other species. From the former rather more than fifty skins were prepared. No selection whatever was made in choosing the individuals for skinning, save that mice with immature or with badly damaged pelage were rejected, while many others were unavailable owing to early decomposition.

The first results of this trapping made it plain that these mice belonged to no specially modified lava-dwelling race. They had retained the pale brown-gray hue, sprinkled dorsally with black, so familiar to us in desert rodents generally. When laid upon the dark lava rocks, they certainly could not be called inconspicuous, as the accompanying figure shows. (Plate 6.)

The fact that this seemingly conspicuous rodent flourishes in such numbers upon these lava fields gives us good ground for skepticism as to the need for concealing coloration among closely related species. And it surely justifies us in challenging those who assume without evidence the existence of a selection so rigid that trifling differences in shade are of frequent survival value.

It should also be mentioned here that none of the other species of mice and rats which were trapped upon this lava field by Mr. Hunt and myself gave any evidence of modification in the direction of deeper pigmentation. The species taken comprised one other *Peromyscus*, two species of pocket mice and a wood-rat. While no extensive series of skins was prepared for these other species, any very pronounced darkening would doubtless have been observed. With a single possible exception, the only noticeably dark pelages were those of juvenile specimens.

Although it was evident that no considerable degree of darkening had occurred among these lava-dwelling representatives of *Peromyscus crinitus*, the question still remained whether there had been any modification whatever, which might be revealed by careful quantitative methods. For this purpose a control set of specimens was necessary.

The control series I should naturally have collected in the Bullion Mountains, a rocky range, a few miles to the southwest, in which I knew that these mice occurred. But the presence of another extensive lava field upon the nearby slopes of this range, was regarded as com-

plicating the situation.[12] We therefore moved to a considerably more distant point. The spot chosen was a rocky range of hills near the village of Oro Grande, on the Mojave River, between fifty and sixty miles to the westward of our previous station. The new locality was some seven or eight hundred feet higher than the previous one, and perhaps differed somewhat climatically, as it did in respect to vegetation. It was, however, a typical stretch of desert country, and many of the more abundant plant species were common to the two regions. The hills along the base of which we trapped were covered with large masses of igneous rock, whose prevailing hues were pale gray, buff and pinkish, interspersed with areas of finer materials (gravel and sand) of a still paler hue. No lava fields or other extensive masses of dark rock occur in this vicinity.

One hundred and thirteen specimens of *P. crinitus*, together with thirteen belonging to other species, were taken in my live-traps in the course of 478 trap nights. Fifty skins were preserved, care being exercised, as before, that the choice of individuals should bear no relation to the color of their pelage.

A superficial comparison of this series of skins with that from the lava field revealed no obvious difference in their average color-tone. A careful quantitative study confirms this first impression. Indeed it seems rather remarkable that two random collections comprising such limited numbers, should agree so closely. The mean readings of the two series,[13] through the three color-screens of the Hess-Ives Tint Photometer, are as follows:

	RED	GREEN	BLUE-VIOLET
Lava	26.2	19.2	16.0
Oro Grande	26.7	19.4	15.9

[12] This second field is rather more than a mile distant (at the nearest point) from the "Pisgah" lava bed on which the trapping was done. The intervening area was occupied by level ground, entirely devoid of rock and likewise apparently of *Peromyscus crinitus*. Elsewhere, the "Pisgah" field is separated by much wider intervals from the nearest rocky hills.

[13] A few skins were rejected from each series owing to immaturity, or to obvious loss of hair. There remained 45 in the lava set, 46 in that from Oro Grande.

Reduced to terms of black, white, and color (in this case a shade of yellow) we have:[14]

	BLACK	WHITE	COLOR
Lava	79.8±0.19	16.0	4.2
Oro Grande	79.6±0.18	15.9	4.5

The trivial excess of black in the lava series is of no statistical significance, as appears from the fact that this difference is less than its probable error. It is to be noted that the lava series likewise shows a trivial excess of white, which is further evidence of the "accidental" character of all these slight differences between the two sets of figures.

Various objections may perhaps be brought forward by critics to the propriety of drawing any general conclusions from this single instance which yielded negative results. It will perhaps be pointed out that I have dealt with a wholly nocturnal animal. I should, it may be urged, have chosen some diurnal species, for which concealing coloration would be more necessary. In reply, I need only remark that two of Doctor Merriam's species (the *Onychomys* and the *Perognathus*) are as completely nocturnal in their habits as is *Peromyscus crinitus*, while the remarks of both Osgood and Goldman likewise apply to nocturnal species.

It may be urged, too, that the lava fields on which I have trapped my specimens are of unknown age and that they are perhaps much more recent than those of the San Francisco Mountain district. I cannot, I confess, meet this argument directly. It is certainly pertinent to point out, however, that the pale *crinitus* mice of this Mojave Desert lava field still succeed in maintaining themselves in great abundance, after a period which is certainly to be measured in centuries, and perhaps by even greater periods of time. This fact does not harmonize well with the assumed rigid selection on the basis of color-tone.

Another objector may insist that *Peromyscus crinitus* may, by reason of special habits, have no need for protective coloration, whereas the same may not be true of various other rodents. This, indeed, is quite possible. If it be true, however, we may well query why this species

[14] Those who have had no experience in color analysis may be surprised by my characterizing as "pale" a shade containing nearly 80 per cent of black. I will merely point out that a piece of faded khaki which I tested gave photometer readings very close to those for these mouse skins, but that the former was slightly darker.

has ever adopted the familiar pale hue, which seems to be an adjustment to the prevailing tones of the desert at large. Either way we take it, the argument seems to lead us into difficulties.

I am prepared, too, for the disparaging comments of such biologists as regard the experimental method as the only key to scientific truth. All this field observation, I may be told, is beside the mark. I should have subjected my animals to experimental tests in the laboratory. As a matter of fact, I have done this very thing, not with *Peromyscus crinitus*, to be sure, but with various subspecies of *maniculatus*. I have thus far found no evident tendency toward convergence on the part of these several races, even after a considerable number of generations in captivity under identical life conditions. Possibly photometer tests of prepared skins will reveal a slight change of color, but this is not yet obvious to the eye. The direct effect of humidity or other physical agents upon pigmentation, if such exists, must manifest itself very gradually in the case of these mice.

In conclusion, let me say that I make no claim that the single case which I have studied intensively affords a disproof of the effect of a lava background upon the coat color of every other mammal. But I do urge that the wholly negative result derived from this seemingly critical case, gives ground for reasonable skepticism, and that it throws the burden of proof upon those who have, thus far, offered us merely generalized impressions or very limited data.

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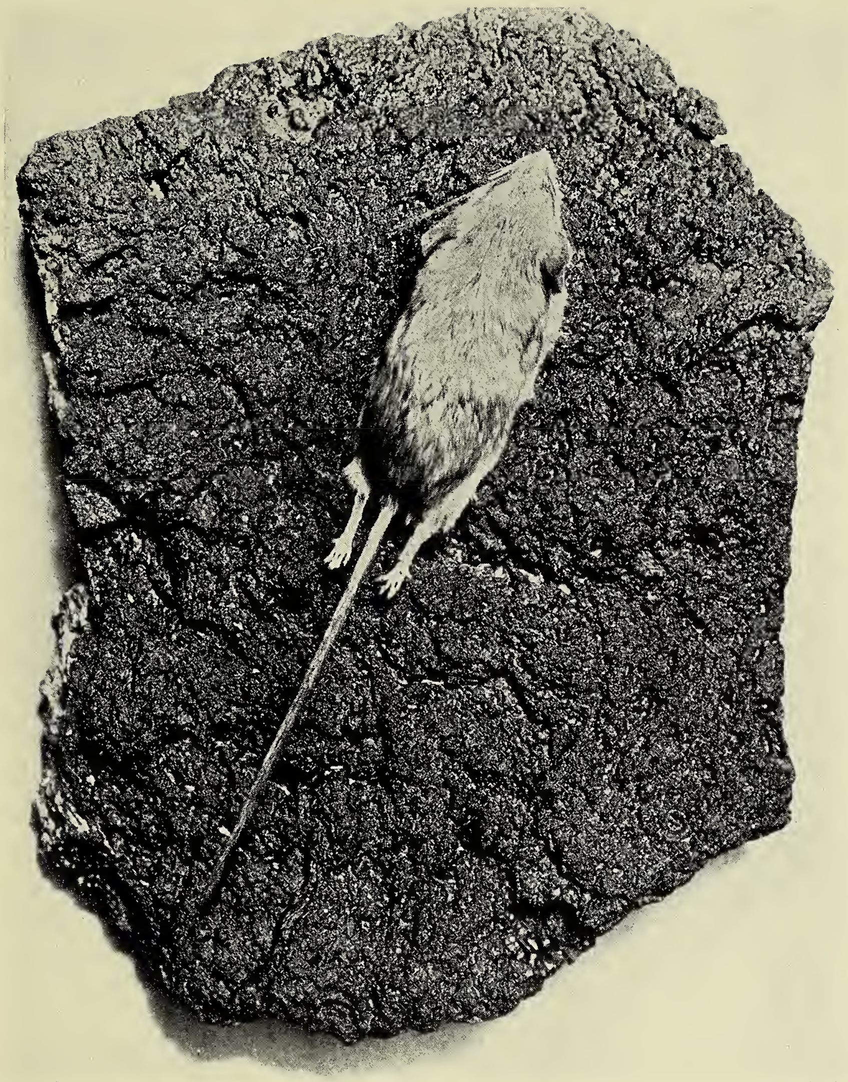

Peromyscus crinitus stephensi FROM LAVA FIELD, SEEN AGAINST A BLOCK OF DARK LAVA

Skin prepared by R. Hunt; photograph by H. R. Fitch. Reduced. The lighting conditions make the anterior half of the mouse appear somewhat too pale. Mus. Vert. Zool., no. 31393.

(Sumner: Desert and Lava-Dwelling Mice.)

THE "HAND-STAND" HABIT OF THE SPOTTED SKUNK

By Charles Eugene Johnson

In the Journal of Mammalogy for February, 1920, there appeared a note by A. H. Howell with regard to a Florida spotted skunk which he had suddenly met with, standing erect on its fore legs. Seton, in the following (May) number of the Journal tells of having seen a similar attitude assumed by the large northern skunk (*Mephitis putida*), when the animal apparently was in a playful mood. Since little seems to be known concerning this rather peculiar habit among skunks the following notes which I was fortunate enough to obtain a few weeks ago may be of interest.

On December 28, 1920, while in the field near Lawrence, I came upon one of the little spotted skunks (*Spilogale interrupta*), common in this region, which at the time was traveling leisurely across a wheat field. It was 11 o'clock in the forenoon and the day was very mild, the temperature being about 50°. When first seen the skunk was about 60 or 70 yards distant. I got out my kodak and gave chase with the intention only of securing a photograph.

When the skunk saw me as I came running toward it, it hastened its gait somewhat and arched its tail and waved it menacingly. I had set the focus at 8 feet and as I caught up with the skunk I dropped into a fast walk and then took a few quick steps toward it in order to get my distance. As I did so, but before I could properly aim the kodak and press the bulb, the skunk, which was proceeding at a rather slow, deliberate trot, suddenly threw its hindquarters into the air and actually ran a few steps on its fore legs. Its body seemed almost perpendicular and the hind legs were spread apart but were also drawn up somewhat toward the flanks; the tail was erect but drooped more or less over the back and sides and twitched threateningly. As the animal threw up its hindquarters it also turned slightly on its fore legs and twisted its body in an endeavor to face me. I stopped short but the skunk immediately dropped back to all fours again and continued running. In making further attempts to get a photograph of the animal I discovered to my great disgust that the shutter, long unused, refused to function properly, so that I ceased my efforts in this direction and gave my attention entirely to the skunk.

On three separate occasions while endeavoring to get a photograph of the skunk I quickly stepped up to within about 6 feet of it as it was running before me and each time the animal performed a perfect

"hand-stand" act. After my last futile photographic effort I stopped a moment to examine the shutter and the skunk meantime gained a little distance. I hastened after it and when near enough threw a clod of earth which struck the ground within a foot or two of its side. Like a flash the skunk threw up its hind legs and half faced about, pivoting on its fore legs, and uttered a hissing snarl. The "hand-stand" attitude, however, was not maintained for more than about half a second, the whole performance being but a momentary pause on the part of the animal to defend itself. Following closer after a brief interval I again startled it, this time by suddenly clapping my hands together and hissing. The skunk merely tossed up its rear to an angle of about 45° and kept on going.

We had now drawn near the edge of the field and desiring to experiment further I endeavored to head the skunk back in the direction whence it came. In this I succeeded for a time but only after much clapping of hands, hissing and various other outbursts on my part. In every instance when I got up rather close to the animal, within 8 or 9 feet to the best of my judgment, and suddenly startled it, it gave the "hand-stand" reaction. Altogether in the relatively short time that I was occupied with this experiment I induced about a dozen of these reactions. A number of times, when I was at a little greater distance, the skunk did not raise its rear so high from the ground; but on several occasions, when I suddenly stepped up close, the body was held in a perfectly upright position with the head straining toward the horizontal.

The last performance the skunk made before I let it go was the most interesting one, and of longest duration. Despite my efforts to prevent it the animal had succeeded in working its way nearer and nearer to the edge of the field where there was cover and where it evidently had a retreat, for it was headed toward this place when it was first seen. A number of times this little beast actually charged me as I stepped in front of it while trying to turn it back, but I retreated hastily and it did not press the pursuit. The last time, however, I held my ground as the skunk bristled and charged directly at me. When within probably 8 or 9 feet of me it stopped abruptly and elevated its rear end, standing perfectly balanced on its fore legs for what seemed at least a couple of seconds. It did not need to turn this time in order to face me; its back was toward me, and its tail drooped slightly over the back as it was waved from side to side in a deliberate but somewhat jerky fashion. The attitude was so erect that the vent was completely exposed to view from where I stood, and was directed upwards.

It seemed as though the animal was endeavoring to aim the charge over its back at me, its instinct to face the enemy being too strong to permit it to turn about and thus be in a more favorable position to direct its weapon.

My companion, who had remained an interested spectator from a little distance, declared afterwards that whenever the skunk rose upon its fore feet a fine spray of vapor could be seen issuing from the vent. This I did not observe, probably because of my proximity and the angle of view. I was perfectly aware of course that discharges were being made. The anal sphincter was actively working whenever the erect posture was assumed; that is, when the skunk was in a position so that the vent could clearly be seen.

After witnessing the above-described performance of the spotted skunk I am strongly inclined to believe that what has here by way of brevity been referred to as the "hand-stand" attitude is a common habit of this and perhaps also other species of skunks, under certain conditions. It is manifestly a defensive attitude primarily, and seems to be taken for the purpose of better directing the discharge of the vile secretion with which nature has provided these animals. The above noted facts are not sufficient in themselves to permit too many inferences or conclusions to be drawn from them, but they at least appear significant. The idea suggested itself that the erect attitude may possibly be resorted to by the skunk, and especially against such of its enemies as stand up higher from the ground, in order to aim the fluid at the most vulnerable part, namely the face. Against an intruder as tall as a man, at close range, there would seem to be no other way to effectively place its shot. Instinctively it is aimed at the face; and the higher the target the greater the elevation of the weapon. If it were attacked by a small dog it hardly seems likely that the skunk would elevate its body to the extreme that has been observed when on its defense against man, for that would be to overshoot the mark. On the other hand it may be that by assuming this attitude the skunk is able more quickly to surround its entire person with a defensive zone. But such points must be left for future observations or experiments to decide.

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ON THE GORILLA AND THE CHIMPANZEE

By C. R. Aschemeier

There have been several articles of late, in magazines and newspapers, regarding the gorilla and the chimpanzee, with particular reference to the bravery in an advance to the attack, as well as to the relative ability to defend themselves, shown by these great apes. The authors have, in some cases, belittled the gallant courage of the gorilla and pictured the chimpanzee as a brave beast. I wish to give an account of several instances when the gorilla proved himself the gallant; and to express my opinion that the chimpanzee is a coward, as compared with the larger ape. These are based on over two years' experience in hunting these animals in the Fernan Vaz District of the French Congo, which is considered the best region for both the gorilla and the chimpanzee.

Contrary to the opinions of many, the gorilla is, in my experience, just as intelligent as the chimpanzee. I found in every case that, in time of danger, the gorilla used his head better than did the chimpanzee. The latter ape seemed frequently to get "rattled," whereas the gorilla, although not necessarily slow, was, at critical times, much more deliberate in his actions. A chimpanzee always makes off at the first sign of danger, but one never knows when the gorilla may attack.

Their cries, in times of great danger, are characteristic of the natures of the two beasts. When I ran into a chimpanzee there was a wild scramble, a piercing scream, and the animal disappeared into the bush. With the gorilla it was quite different. There was usually a single yell, one that seemed fairly to make the earth tremble, and this was sometimes accompanied by a beating or thumping of the chest. The gorilla, in his deliberate retreat, usually keeps a tree between himself and the hunter.

I was a witness to several instances when gorillas refused to desert their fallen comrades. One morning on the Rembo Elandi, not far from our camp, we encountered a family party of five or more gorillas. Some of them, apparently, had not yet risen from their beds. One old male was on the ground, two were in the trees eating, and the rest were in the nest. One of my native guides advanced as far as was safe, actually to almost under the tree in which the two were feeding, and had the opportunity for close observation of what followed. I shot at one of these gorillas, an animal about two-thirds grown, and saw it tumble from the tree. I ran forward, to find the native standing in

surprise at what he had seen. Just as he was beginning his explanation, an old gorilla that had still remained in its bed arose and with a mighty yell retreated into the timber. The guide explained that the gorilla I had shot from the tree fell to the ground, apparently dead, but that another gorilla had rushed up, gathered it in his arms, and carried it into the bush.

Another time, Pambo, my best guide and helper, went into the bush with another native. Not long after I heard shots and very soon both natives came running, scratched from the bush and out of breath. They said that soon after entering the bush they encountered a large family of gorillas. Pambo said he shot a large female and that a male immediately approached in a very threatening manner, picked up the wounded female, and made off. On turning around the men saw another large male making at them. This one apparently meant business so they ran as fast as they could to get out of his reach.

On two occasions I captured young chimpanzees, but only once did I come near to getting a young gorilla alive. In this case a mother gorilla strayed a bit farther than usual while the baby was feeding. We had heard the animals in the bush, and were advancing cautiously when we saw the young one on the ground. We were closing in to capture it when suddenly we heard, on both sides, the swishing of bushes. Both parents were coming to the rescue as fast as they could. The smaller, presumably a female, went straight to the youngster, picked it up, and stood looking us full in the face. The old male arrived near these two very quickly, and on seeing us gave the terrible gorilla cry, and started off in the lead. As we followed, he dropped to the rear to guard the mother and young. This was one of several times, when the parents showed signs of willingness to sacrifice their own lives for the young, that I did not shoot.

I have frequently been asked as to the probable result in a combat between a gorilla and a chimpanzee. To begin with, one must take into consideration the weight, height, and reach of the two beasts. I shot two grown gorillas that measured five feet, one inch and five feet, three inches in height. The largest adult chimpanzee I got measured four feet and weighed about 150 pounds. The gorillas weigh from 300 to 350 pounds, practically twice as much as the chimpanzees. The chimpanzee is undeniably a strong beast, but the gorilla is just as strong, comparatively, and has the natural advantage of larger size and strength. I think that in the event of an encounter, the gorilla would by sheer weight and strength, wear the chimpanzee down. I

asked native gorilla and chimpanzee hunters which one was the most dangerous game, and the answer was always in favor of the gorilla. To get a real good close-up view of a live gorilla is a treat indeed.

Other questions often asked me on my return from Africa were: Do gorillas or chimpanzees capture native women and carry them off into the bush? And: Will the gorilla advance to attack unless he is wounded? As to the first question, I asked natives in all the localities I visited if such was the case and the answer was always in the negative. I saw several natives, both men and women, however, who had been badly wounded by gorillas. As to the second question, yes. I had gorillas deliberately advance on me and on account of the density of the brush I had to retreat. I found, though, that when a gorilla came at me it always gave up the chase in a little while.

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THE RED SQUIRREL OF THE SITKAN DISTRICT, ALASKA

By H. S. Swarth

The red squirrel of southeastern Alaska was placed with *Sciurus hudsonicus vancouverensis* by J. A. Allen in his "Revision of the Chickarees," where *vancouverensis* was first described (Bull. Am. Mus. Nat. Hist., vol. 10, 1898, p. 269). The present writer, in a report upon a collection of birds and mammals from Vancouver Island, comments upon certain features that distinguish the red squirrel of southeastern Alaska from typical *vancouverensis* of Vancouver Island (Swarth, Univ. Calif. Publ. Zool., vol. 10, 1912, p. 88), without formally naming the Alaskan race. Further study of the red squirrels of the northwest coast region has emphasized the desirability of giving a name to this Alaskan form. It may be diagnosed as follows:

Sciurus hudsonicus picatus new subspecies

KUPREANOF RED SQUIRREL

Type.—Male adult, skin and skull; no. 8767, Mus. Vert. Zool.; Kupreanof Island, 25 miles south of Kake Village, at southern end of Keku Straits, southeastern Alaska; April 23, 1909; collected by H. S. Swarth; original no. 7281.

[1] Contribution from the Museum of Vertebrate Zoology of the University of California.

Diagnosis.—A red squirrel with the general characters of *Sciurus hudsonicus*. Cranially, most nearly resembling *Sciurus hudsonicus petulans;* externally, more nearly like *S. h. vancouverensis.*

Comparisons.—*Sciurus h. petulans,* as compared with *vancouverensis,* is stated by Osgood (N. Am. Fauna, No. 19, 1900, p. 27, pl. V, figs. 1, 2) to have the "nasals longer and posteriorly more compressed than in *vancouverensis;* orbital arch with a sharp indentation between lachrymal and postorbital process." These differences do not exist between *petulans* and *picatus.* There are individuals in the latter series that show intergradation toward *vancouverensis* in shape of nasals or in partial elimination of the orbital indentation described, but the series as a whole is, cranially, not to be distinguished from *petulans.*

As regards color, *Sciurus h. picatus* is dark as compared with *petulans,* but it is distinctly brighter than *vancouverensis.* The differences are most apparent in winter pelage; in the summer coat the two forms are closely similar in general appearance, differing only in certain minor details. In the winter coat *vancouverensis* is nearly uniform dark chestnut above, with the reddish dorsal stripe poorly defined; the tail is reddish above, but decidedly grayish on the ventral surface. In *picatus* the reddish color is generally brighter, there is a fairly well-defined hazel dorsal stripe and the center of the tail below is reddish. The black lateral stripe on the body is much more prominent. In all pelages *picatus* has the tip of the tail much less extensively black than is the case with *vancouverensis.* *Sciurus h. picatus* is slightly the larger of the two. For external measurements of *Sciurus h. picatus* and *S. h. vancouverensis* see Swarth, Univ. Calif. Publ. Zool., vol. 10, 1912, p. 88.

Distribution.—The area inhabited includes parts of the Sitkan district, Alaska, and extends for an undetermined distance southward. There are specimens at hand from the following islands: Kupreanof, Kuiu, Mitkof, Wrangell, Zarembo, Etolin, Revillagigedo, and Sergief. From mainland points: Taku River, Thomas Bay, Stikine River, Bradfield Canal, Chickamin River. (For details of distribution see Swarth, Univ. Calif. Publ. Zool., vol. 7, 1911, pp. 118, 153, map, fig. 1.)

Remarks.—The material upon which the above comparisons are made is as follows: *Sciurus h. vancouverensis,* 28 specimens from Vancouver Island (Mus. Vert. Zool.). *Sciurus h. picatus,* 36 specimens from the Alaskan localities previously indicated (32 in Mus. Vert. Zool., 4 in the E. P. Walker collection). *Sciurus h. petulans,* 17 from Glacier Bay (Mus. Vert. Zool.), 4 from Wells, Chilkat Valley (E. P. Walker collection).

The Glacier Bay specimens appear to be typical of *petulans.* The four skins from Chilkat Valley are, in color, intermediate between *petulans* and *picatus;* the skulls are not available. In his description of *petulans,* Osgood (loc. cit.) treats *vancouverensis* as a distinct species, a view that has since been disregarded (see Miller, List of North American Land Mammals, 1912, p. 321), and which my own material controverts. The race *picatus* is in itself intermediate between *petulans*

and *vancouverensis*, and in the *picatus* series there is individual variation tending to bridge the gap in either direction. The indentation in the orbital arch, given by Osgood as a feature distinguishing *petulans* from *vancouverensis*, is not a character to be absolutely relied upon. This little notch is sharply indicated in the *petulans* series, as I believe it is in the red squirrels of the interior of the northwest generally. In the Vancouver Island skulls at hand there are none in which it is at all deeply cut. In some it is entirely absent, but usually there is a suggestion of a notch at that point. The southern Alaskan series contains none in which the notch is as nearly eliminated as in most of the Vancouver Island skulls, and as a rule it is as apparent as in the *petulans* series. It is not a character the presence or absence of which can be indicated in each of the skulls; it appears in all degrees from one extreme to the other.

Berkeley, California.

REVISED LIST OF THE SPECIES IN THE GENUS DIPODOMYS[1]

By Joseph Grinnell

A bare list of names is a pretty poor offering, not ordinarily worth printing. But in the present revised list enumerating sixty species and subspecies of kangaroo rats a good deal of new information is set forth in a concentrated form. The main basis of this contribution is a relatively extensive systematic and distributional study of the genus as occurring within the limits of California. The more comprehensive report upon this study is likely to be long delayed in the press, if, indeed, it ever sees the light of publication.

The 33 forms now known to occur in this state (California) have been determined upon after examination of a large amount of material, over 2800 skins with skulls. Confidence as to their status is much greater than with most of the remaining forms, of which material has been accessible in only scant amount. Still, first impressions, as gained of the latter, may be worthy of consideration, when gathered upon the basis of the rather intensive study of the other forms.

The "*ordii* group" is accepted practically as revised by Goldman (Proc. Biol. Soc. Washington, vol. 30, 1917, p. 113).

[1] Contribution from the Museum of Vertebrate Zoology of the University of California.

The species are arranged by "groups" from what appears to be the most generalized type to the most specialized. These groups are not at all comparable in rank to the subgenera currently recognized in some other families of rodents; in fact the genus *Dipodomys* as it stands seems to be remarkably compact and homogeneous. Yet the groups indicated do serve to express probably more close genetic relationship among the constituent species of each group than that obtaining between species representing different groups.

HEERMANNI GROUP

Dipodomys heermanni heermanni LeConte
Dipodomys heermanni californicus Merriam
Dipodomys heermanni eximius Grinnell
Dipodomys heermanni tularensis (Merriam)
Dipodomys heermanni dixoni (Grinnell)
Dipodomys heermanni berkeleyensis Grinnell
Dipodomys heermanni goldmani (Merrian)
Dipodomys heermanni jolonensis Grinnell
Dipodomys heermanni swarthi (Grinnell)
Dipodomys morroensis (Merriam)
Dipodomys mohavensis (Grinnell)
Dipodomys leucogenys (Grinnell)
Dipodomys panamintinus (Merriam)
Dipodomys stephensi (Merriam)
Dipodomys ingens (Merriam)

SPECTABILIS GROUP

Dipodomys spectabilis spectabilis Merriam
Dipodomys spectabilis cratodon Merriam
Dipodomys nelsoni Merriam

PHILLIPSII GROUP

Dipodomys phillipsii Gray
Dipodomys perotensis Merriam
Dipodomys ornatus Merriam
Dipodomys elator Merriam

MERRIAMI GROUP

Dipodomys merriami merriami Mearns
Dipodomys merriami ambiguus Merriam
Dipodomys merriami atronasus Merriam
Dipodomys merriami parvus Rhoads
Dipodomys merriami simiolus Rhoads
Dipodomys merriami arenivagus Elliot

Dipodomys merriami melanurus Merriam
Dipodomys nitratoides nitratoides Merriam
Dipodomys nitratoides exilis Merriam
Dipodomys nitratoides brevinasus Grinnell
Dipodomys platycephalus Merriam
Dipodomys margaritæ Merriam
Dipodomys insularis Merriam
Dipodomys mitchelli Mearns

ORDII GROUP

Dipodomys ordii ordii Woodhouse
Dipodomys ordii columbianus (Merriam)
Dipodomys ordii monoensis (Grinnell)
Dipodomys ordii utahensis (Merriam)
Dipodomys ordii chapmani Mearns
Dipodomys ordii obscurus (Allen)
Dipodomys ordii montanus Baird
Dipodomys ordii longipes (Merriam)
Dipodomys ordii luteolus (Goldman)
Dipodomys ordii richardsoni (Allen)
Dipodomys ordii palmeri (Allen)

COMPACTUS GROUP

Dipodomys compactus True
Dipodomys sennetti (Allen)

AGILIS GROUP

Dipodomys agilis agilis Gambel
Dipodomys agilis simulans (Merriam)
Dipodomys agilis peninsularis (Merriam)
Dipodomys agilis cabezonæ (Merriam)
Dipodomys agilis perplexus (Merriam)
Dipodomys venustus venustus (Merriam)
Dipodomys venustus sanctiluciæ Grinnell
Dipodomys elephantinus (Grinnell)

MICROPS GROUP

Dipodomys microps (Merriam)
Dipodomys levipes (Merriam)

DESERTI GROUP

Dipodomys deserti Stephens

Certain names which have been bestowed upon kangaroo rats will not be found in the above list for the reason that they are considered by the present reviewer as applying to forms named previously. These synonyms, and their allocations, are as follows:

helleri of Elliot = *deserti* of Stephens
kernensis of Merriam = *merriami* of Mearns
mortivallis of Elliot = *merriami* of Mearns
nevadensis of Merriam = *merriami* of Mearns
nitratus of Merriam = *merriami* of Mearns
pallidulus of Bangs = *californicus* of Merriam
similis of Rhoads = *simiolus* of Rhoads
streatori of Merriam = *heermanni* of LeConte
trinitatis of Kellogg = *californicus* of Merriam
wagneri of LeConte = *agilis* of Gambel

These cases have been worked out at some pains and are reasonably certain. There are very likely a few names in the main list above that will eventually have to be synonymized also. But on the other hand there are undoubtedly many more good new forms to be named. So that future systematic workers in this interesting genus will find much yet to do.

Berkeley, California.

DESCRIPTION OF A NEW SPECIES OF PHENACOMYS FROM OREGON

By A. Brazier Howell

[*Plate 7*]

Among some skins with uncleaned skulls, which were kindly loaned me for study by Stanley G. Jewett, was a *Phenacomys* which appeared to belong to a new species; and after the skull was cleaned all doubts of this were removed. Mr. Jewett has generously given me permission to describe this new form, which may be known as

Phenacomys silvicolus new species

FOREST LEMING-MOUSE

Type.—Young adult female; No. 1214, Coll. of S. G. Jewett; 5 miles southeast of Tillamook, Tillamook County, Oregon; October 25, 1916; collected by Peter P. Walker; Orig. No. 40, Coll. of Alex. Walker.

Diagnosis.—Externally, closest to *Phenacomys longicaudus*, with a general appearance and tail very similar to that form; but darker and with smaller ears. The skull is longer than that of *longicaudus* of corresponding age, with narrower braincase having temporal ridges, with much heavier molariform teeth of a different pattern, and with pterygoid plates which flare anteriorly on their outer edges.

Description.—The hairs on the back of *silvicolus* are fine and long, some of them reaching a length of 15 mm. The bases are plumbeous, and the distal ends sayal brown, sparsely tipped with black. The coloration is slightly paler on the sides, and rather abruptly white on the ventral surface, the hairs of the latter area having plumbeous bases. The feet are soiled whitish with long toes and claws as in *longicaudus;* and the tail is covered with long, blackish hairs as in that species. The ears are small and do not project beyong the body hairs.

The skull is quite different from those of *P. orophilus*, *P. albipes*, or *P. longicaudus*. In comparison with the last-named species, which is evidently its closest relative, the skull of *silvicolus* exhibits the following characters. The braincase is flattish, long and comparatively narrow. The nasals are somewhat constricted at a point posterior to the middle, with the ascending extremities of the premaxillæ narrower. The zygomatic processes of the maxillæ slope rather evenly from the rostrum, and the zygomatic width is greatest in the anterior region of the jugals, with the latter converging somewhat posteriorly. The temporal ridges are very pronounced and are parallel in their posterior halves, thence joining the vertical ridges of the squamosals. The postorbital processes of the squamosals are poorly developed and are not "peg-like." The incisive foramina are large and are not in the least constricted posteriorly. There is a distinct "hump" at the juncture of the basi-occipital with the basi-sphenoid,

and the anterior portion of the latter is very narrow, forming considerable vacuities between it and the pterygoids. The pterygoid plates are unusual in that they gradually form lateral shelves anteriorly, and the interpterygoid fossa is wide, with the palatal pits more pronounced, although smaller, than in *longicaudus*. The audital bullæ are slightly larger.

The molariform teeth are even heavier and broader than in *orophilus*, with the tooth row considerably longer than in *longicaudus*. The teeth are further characterized by the wide, sweeping lines of the enamel folds, and by the tendency of all the molar angles in the lower jaw to remain open. This species of *Phenacomys* is unique in having not more than three closed triangles in $\overline{M1}$. There are no closed triangles in $\overline{M2}$, and the antero-external loop is wide open. $\overline{M3}$ is simple and somewhat as in *longicaudus*. The upper molariform teeth show no notable peculiarities in the enamel pattern.

Measurements.—Type: Total length, 191[1] mm.; tail, 81[1]; foot, 32[1]. Length of skull, 25.1; zygomatic width, 14.4; interorbital width, 3.4; mastoid width, 11.8; upper molar row, 5.9.

Remarks.—The type specimen was found dead on a log on a ridge which is covered with first-growth Douglas fir (*Pseudotsuga taxifolia*). The writer spent several weeks in this region during September, 1920, and, with the generous coöperation of P. P. Walker and A. Walker, to both of whom he is deeply indebted, made a search for this animal. All convenient patches of second-growth fir were searched for nests, and many hundreds of traps set without result. Virgin timber was also examined, but with very little hope of success, for the trees are so large, and so festooned with long moss, that each might contain a score of hidden nests.

P. longicaudus is the only species of the genus that is definitely known to lead an arboreal life. Also, it was previously the only known form with a long, *hairy* tail. Our knowledge of the habits and characters of other families (e.g., Sciuridæ) gives us grounds for presuming that hairiness of tail may be considerably increased by a life in the trees. The tail of *silvicolus* is just as hairy as is that of *longicaudus*, and, in addition, both have toes and claws that are unusually long and well fitted for climbing. Hence, it is a logical conclusion that one species is just as arboreal as the other.

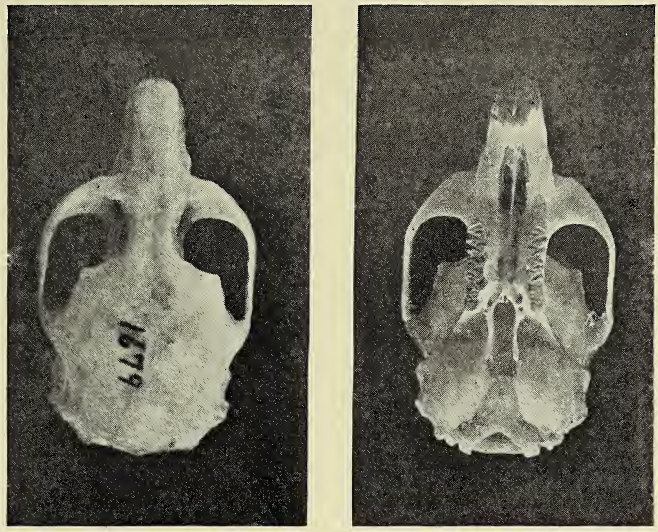
Mr. Jewett informs me that *longicaudus* has been taken as far north as the Columbia River, so this form probably occurs in scattered colonies throughout the coast district of Oregon. The type locality of *silvicolus* is typical of all the humid, timbered area of that state, and one may presume that the new species is rather widely distributed.

[1] Collector's measurements; that of the foot is obviously an error and should be 22 mm.

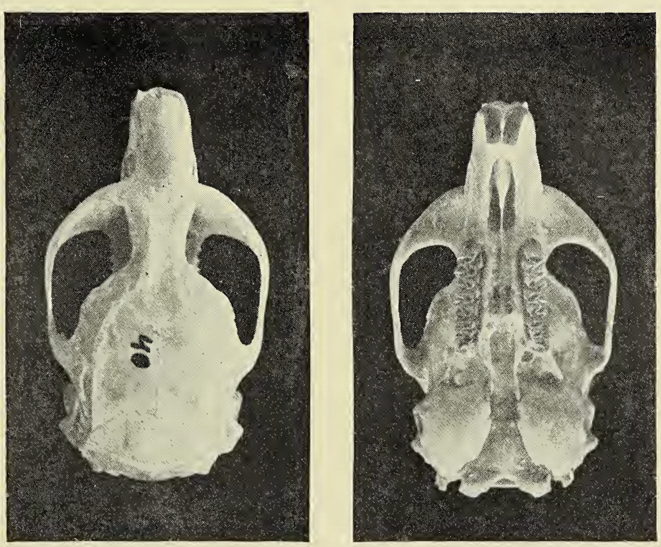
Therefore, the two species may well occur together, for although both are undoubtedly arboreal, they may occupy different ecological niches, and have different food habits. It is interesting to note that *P. albipes* is found on the floor of these humid forests, its association seeming to be definitely riparian, and thus there are three distinct species of this genus inhabiting the same faunal area—a condition that is, so far as known, unique.

The relationship of *silvicolus* is not clearly indicated. As mentioned, the external appearance places it with *longicaudus*, and it is probably closest to that form, but its skull does not resemble skulls of *longicaudus* to any greater degree than it does skulls of *albipes*, and the apparent similarity may be due solely to the influences of parallel habits acting upon two separate stocks.

Pasadena, California.



Skull of *Phenacomys longicaudus*. × 2



Skull of *Phenacomys silvicolus*. Type. × 2

(Howell: New Phenacomys from Oregon.)

NOTES ON THE SNOWSHOE RABBIT

By J. Dewey Soper

To the average lover of the open, the life-history of the snowshoe rabbit cannot have escaped a certain measure of familiarity. Usually it is the most common animal of the woods and it would be difficult for even a casual saunterer to overlook it. There has sprung up quite an extensive literature concerning it, and it seems impracticable for the present purpose to attempt a full account of its life-history. So I propose only to amplify certain less frequently considered phases. This idea came to me recently from thumbing through the pages of some old field journals, recalling to mind many incidents pretty well dimmed by the passage of time, but now revived, together with a host of minor episodes not recorded by the pen. It has many times occurred to me as peculiar that some of the most palpable of facts escape the notebook. Perhaps it is because of the very quality of commonness that this is so, and only the unusual facts find their way into the chronicles of the fields.

Most of the notes in this instance were collected in the wilds, in the Indian country, in the late fall and winter, and as previously intimated, I enjoy a very vivid recollection of numerous occurrences which various wayward journeyings have afforded. I also have found discrepancies in the life of the snowshoe rabbit there, from that which ordinarily obtains in the settled East sufficient to compel that striking interest which follows fresh discoveries.

The lives of the various individuals of a species are very different, depending largely upon their situation. The relationship of a hare to its environment in an eastern swamp, encircled by prosperous farms, for instance, cannot be precisely similar to that of another in the relatively uninhabited forests of the North. Its mode of existence basically may be nearly or quite the same, but occasional events change the effect as a whole. These may be trifling or the reverse but the consequences are perceptibly altered from the standpoint of the animal, and a fresh slant of interest afforded its chronicler. For this reason, I suppose, a very great deal may be written concerning any of our animals of wide range, without materially duplicating in detail former experiences.

It would be difficult to visit the northern wilds under ordinary conditions without striking up some acquaintance with the snowshoe rabbit. Its presence is often of the most obtruding character. There are seasons though when its absence becomes quite as singular as is its abundance at other times. The phenomenal balance maintained in the perpetua-

tion of this species is one of the wonders of nature. The marvelous fecundity of the animal as seen in the usual seven-year cycle of abundance, seems a reflection on the beneficence of nature, when such numbers subsequently are so effectually reduced. But without some provision for reduction the final consequences would be rather appalling. It is certain that in time all herbaceous things would disappear. The country would lie in devastation before the progeny of such a prolific race. Of course if this did occur the balance would be struck again when the rabbits all passed away in starvation, but nature proceeds in a more cautious manner without such waste on both sides.

It so happened, that upon my first visit to the West in 1912 the rabbit population was at its height. It was such a revelation after my eastern experiences, so startling, that the vividness of their abundance can never leave me. A certain brushy flat adjoining the White Mud River, southwest of Edmonton, yielded the initial surprise. It was grown to scrub willow, the common trembling aspen, and to some extent with rank under-vegetation. The place was infested. I do not hesitate to say that over that tract of perhaps thirty acres hundreds of hares were found. October had come, without snow. The rabbits had already, wholly or in part, donned their snow-white livery of winter, and were consequently very conspicuous against the mellow brown of the autumn woods. At every turn during my ramble they popped up here and there and scurried for fresh cover. Not only in singles, which was astonishing enough, but often twos and even threes started up in wild alarm. The newness of such an experience does not soon wear away. One receives a peculiar thrill at each additional incident. Scarcely has one received the impression of the previous fleeing object than perhaps another startlingly rockets out from nearly underfoot, stirring up several more in the haste of evacuation. After the first wild impulse of flight which is generally deferred until the last moment, the rabbit bounds leisurely away, sometimes out of sight but as often calling a halt within a few yards. Alarm gives place to a very singular curiosity. Individuals with really admirable nonchalance describe a dozen leisurely jumps, halt, assume an attitude of keen inquiry, a rigid immobility popularly known as "freezing," and wait. That pause is oftentimes fatal. They appear bold or indifferent because of their very numbers. These snowy figures like statues in the distance form one of the features of a woodland ramble.

Over the country to which these remarks broadly refer, namely, the northern and western parts of Alberta, the rabbits often become a

plague. The toiling trapper, depending on the effectiveness of each of his traps, they drive to a form of desperation.

Night after night along the whole long line the cubby or bait pens are torn down or in some way molested. The bait frequently disappears, the traps are sprung, and in a good many instances (sometimes half of them) the rabbit sacrifices his life to his curiosity. The traps thus set

THE SNOWSHOE RABBIT

These snowy figures like statues in the distance, form one of the features of a woodland ramble

for costly fur-bearers are consequently rendered useless—filled with "trash" as it is regarded. The best that can be done is to remove the rabbit carcass from the "set," wedge it overhead in a forked tree, make all additional provisions against the blundering in of others, and resume chances. I can vouch for it as being rather disheartening work for I have taken as high as a dozen hares from a line of twenty lynx traps in a single morning. There is a method of adjusting a fine bent twig under the pan of a large trap to prevent the smaller species from springing the trap, but the idea is not practical except when employed on the

largest traps. The reason for all this tampering with meat baits by rabbits, leads to a subject which, I believe, is not widely known and to which I will refer later.

Eventually, evidence of the inevitable decline arrives. Empire among the rabbits as elsewhere has its rise and fall, and then is swept away. A strange peril stalks through the woods; the year of death arrives. An odd rabbit drops off here and there, then twos and threes, then whole companies die, until the appalling destruction reduces the woods to desolation. There is something almost spectacular in its compass, in its silent and sinister progress. I have walked the woods where formerly hundreds of playful rabbits dwelt, where signs were evident on every hand, yet the woods were empty. A peculiar sense of loneliness comes over one under such circumstances. One year (1917) in the district of Sudbury, northern Ontario, the signs of rabbits were everywhere but not a single rabbit could I start. It seemed incredible. Local inquiries disclosed that a little over a year before the *Lepus* population was beyond count. Now as if by magic they were gone. Needless to say, however, a few individuals survive the epidemic. These now, because of their paucity are seldom encountered. The following year at Ridout, same locality, I observed a noticeable increase. Not that they were plentiful or even common, by any means, but there were frequent trails in the early snow and I started occasional animals. In these few existed the prophecy of another dominion.

There is such a sense of sociability in a wilderness well stocked with these animals, that a subsequent lack of them is at once appreciated. One is sensible of a loss. In the same way the moose bird with his quaint talkative ways becomes one of the presumptive elements of a camp. One night while we were camped near the Athabaska, with a mere square of canvas sufficient only to deflect the wind, it snowed, a calm fluffy fall of several inches. It fell over and about our sleeping forms and in the morning imprinted in it were the tracks of rabbits all around us. They had nosed up to every conspicuous object about camp—the water pail, ax, overturned boots, etc., had even kicked the ashes of the extinct camp fire over the snow and eventually to their satisfaction I presume had solved the enigma of this sudden encampment in their midst. Several trails completely circled our camp. At the time we were entirely unconscious of these frolics. On other occasions morning betrayed their fearless errands about camp, during which they had actually browsed on a quantity of spruce boughs placed to resist the wind at our heads. Again we knew nothing of it until day-

light. Small wonder it is, that the winter wilderness seems less empty and forlorn with such antics of the wild ones about one's habitation.

After the completion of our new log cabin on the Hay River, Rocky Mountain region, in 1913, the rabbit population soon discovered us. The aromatic wealth of spruce boughs that littered the little clearing spread its fame abroad. Perhaps never before in this region had hospitality spread such a lavish *table d'hote.* As dusk descended rabbits came hopping into the enclosure from every direction. There was no evidence of their presence beyond the silent flitting forms passing lightly from place to place. With only the soft sombre wail of the pines and spruces how phantom-like they seemed in the gloaming: now prominent, now melting into the shadows, now motionless, now shifting here and there, spectre-like in the sober stillness. One sparkling moonlight night they visited the clearing in unusual numbers. It was such a night as carried the "yip" of the foxes over long distances with startling distinctness. In the deeper shadows of the spruces an owl mournfully hooted at long intervals. A strange magic charged the brilliant frosty night. One by one they capered into the zone of moonlight. All seemed imbued with a spirit of festive joviality, doubling about with playful pranks and short sallies of wild abandon but ever and anon returning to the sumptuous feast.

Observed from the cabin window, this pantomime went constantly on; the revelers seemed never to tire. Some fed, some frolicked as in games of tag, but a rigid alertness never for a moment ceased. Always one or more of the company sat erect on its haunches, alert, ears forward, nose aquiver, sifting the implications of the night. One ominous sound or sign was enough to scatter this merry assemblage to dark and distant shadows. When one watcher went down another was already acting as sentinel. Still new arrivals came hastening along the ramifying trails. It seemed probable that the entire rabbit population within a wide radius were conscious of this regal occasion. At one time we counted twenty-five in easy view; double that number were possibly present, some hidden behind the piles of boughs or in the shadowy outskirts of the moonlight. Fresh arrivals there were always; and some departures. To calculate accurately their numbers was impossible. When we turned in for the night they still played, and perchance the pallid dawn and the waning moon alone ushered them back to the shelter of the thickets. Truly it was a rare scene and one which to-night, after seven years, lingers in my memory as though it passed but an hour ago.

Wa-poos, as the Crees call him, plays a very important part in the Indian diet, besides furnishing the skins from which their famous rabbit-skin winter robes are made. In the many instances in which I have had occasion to visit Indian wigwams, winter cabins, or in coming accidentally upon their shifting camps, signs of the defunct hare were almost always present. Such bones and feet and fur as had escaped the hungry dogs bestrewed the near landscape. When we arrived at the Fish Lakes in early October, 1913, a number of Indian youths were stalking about in the thickets bordering the lake and outlet hunting snowshoe hares with the primitive bow and arrow. Nor did they lack the skill to get them. The Indian seldom wastes ammunition in getting the hare, the main dependence being placed in the snare. Invariably, in fall and winter at least, as one approaches an encampment large or small, the rabbit snare is conspicuous. A small spruce lies prone, a few branches lopped out underneath forms an opening, and in this reposes the treacherous snare attached to a balance pole secured to a neighboring tree. *Wa-poos,* sniffing the fresh-fallen spruce as invariably he does, nibbles and hops along. Then coming to the inviting lane in the tangle, he dives through, releases the snare and is jerked aloft, a grotesque kicking figure soon to be silenced forever. The snare is a very simple arrangement and very effective. Perhaps a score may be scattered about the camp to a distance of fifty or more yards, further afield if it is a permanent camp. I carefully took note of the structural peculiarities of this snare as employed by the Crees and early pressed it into service on my own account as a means of providing bait for a long line of traps. During the period of trial in which several snares were doing duty about my cabin, an Indian spied one while passing the clearing. I chanced to be near, and the pleasure he evidenced in this work of emulation was an entertainment seldom afforded among this people. His stoical countenance became transfigured with half-a-smile as he turned with some such expression as *Me-wa-ne-pa-hou* (good to kill).

Few animals are considered more strictly vegetarian than the rabbit, yet occasionally it develops tastes to the contrary. This at first was quite a surprise to me. It has no capacity however for gratifying such carnivorous inclinations by any effort of its own, except that of killing young leverets which it is supposed at times to do. On the contrary, any meat which it has access to under ordinary wilderness conditions is supplied by some outside agency. The habit of robbing trap cubbies of bait leads to various consequences. I have known them to demolish a cubby of wooden chunks completely in the effort to reach a frozen hindquarter of one of their own species. The entrances to these cub-

bies intended for ermine and designed to exclude the hare are so small that they really adopted the only method serving to attain their object. Especially when yielding to cannibalism do they appear to go far beyond proper bounds. The flesh of one of their own kind is fully as acceptable as any other. Frozen meat they seem to prefer. When one of their number is killed say by a rifle ball, and left lying, the living of the locality turn to and make a sordid repast. They start from the wound by licking away the blood, gradually nibbling the flesh and tearing the fur back. I cannot recall ever having seen a perfect body molested, such as one taken from a snare. It appears that a wound or tear exposing the flesh is necessary before a start is made. So accurately does the following published letter to Ernest Ingersoll reflect my own experiences in this respect that I can do no better than quote it for additional detail.

Dear Editor: I read with interest "U. S.'s" letter to you in the issue February 13 concerning Animal Cannibalism as noticed by him among wild rabbits.

I can endorse every word he says about dead rabbits being regularly eaten by their own kind in this part of Canada. It is a common occurrence on bright evenings to see rabbits about my shack, or near the stables gnawing at any dead rabbits or part of one left in the snow; and as a rule, very little is left of the carcass in the morning except the skin and bones. They will, however, rarely touch a whole rabbit left with the skin on but one that is torn, cut up, or partly skinned they make short work of. They will also eat any other animal with the skin off, as anyone who has done any trapping for weasels, etc., in the far north well knows. Baits are regularly pulled down and eaten up to the bone; and the trouble here is stopping the little cannibals from springing your traps. The rabbits in this district are healthy enough, and have no lack of food in poplar bark, hay, etc., but they never fail to gnaw the flesh off the bones of a dead comrade, and have done so, to my personal knowledge ever since I came into this country six years ago.

As you seem to have a doubt on the matter I may add that my experience is also the experience of my friends and neighbors, and no question of mistaking tracks in the snow can arise, as anyone can watch the rabbits any evening enjoying a supper of flesh by just throwing down near the haystack the cut-up carcass of another rabbit, muskrat or any other small animal.

Clyde, Alberta. F. B.

In passing I wish to make reference to the peculiarity of this species in taking to the water. I think this habit is little recognized as of actual occurrence, much less as one practiced more or less regularly, and free from the nature of accident. Although the evidence is indubitable on this score I instinctively feel that this essentially woodsy and fluffy creature resorts to such measures only on rare occasions. However this may be, it is certain it has no hesitation at times in voluntarily swimming rivers of modest width. Just how frequently such aquatic

excursions are made, remains of course unknown. The trouble is, that in summer there is lack of sign and in winter the necessity no longer exists. Ocular evidence can occur only as a rarity. Occasionally one comes upon "sign" such as the following.

While traveling one winter day down the Hay River in western Alberta I came to a narrow part of the course where the constriction of the banks forced the water to greater speed. Here there was an open riffle of several hundred yards in length by about four or five in width. Otherwise, ice covered the entire river. This rift of dark swift water in mid-channel raced along at about eight or ten miles an hour. Presently in the fresh fallen snow I noticed the tracks of a snowshoe rabbit, leading down from the timber on my left, across the shore ice, and terminating on the brink. Walking down stream I solved the puzzle by seeing a sodden splash in the snow on the further side where the animal had been swept down and had clambered out dripping from the plunge. The tracks were then resumed across the white snow field, disappearing in the woods beyond. This was the first time I ever noticed this occurrence, was indeed the first intimation that a rabbit ever even wet its feet unless forced to do so. The nature of the trail in this instance proved it to be an action of leisurely choice. No fox or ermine trailed along in the wake of a wild bounding hare ready to submit to water rather than to jaws, for back trailing I found nothing calculated to urge the rabbit from its own placid ramble. To our ordinary everyday conception of its nature the whole affair seems a paradox. I know I was utterly taken back at the time, but was forced to accept the evidence of my own eyes. Since then I have heard or read of similar observations by others. I have, by the way, in years since, known red squirrels to do the same thing. On one other occasion a couple of years ago in New Ontario, I had further evidence of the hare's accomplishment as a swimmer. The conditions were similar to the incident already related.

When such things at times crop up and tax our credulity on a basis of unimpeachable evidence, how eloquently it argues for untraveled byways in nature which we have yet to explore. There is something vital in the reflection that there are puzzles to solve, occultisms to stumble upon. When such phases in the life-history of our native mammals, thought previously to be well understood, suddenly appear from the unknown or what we consider as the improbable, what absorbing facts, perhaps, remain still to be learned from the lives of the hunted.

Guelph, Ontario.

GENERAL NOTES

OPOSSUM IN VERMONT

A full grown opossum was caught by A. A. Roberts, a professional trapper, at Dorset, Vermont, in the heart of the Green Mountains, in mid-December, 1920, long after the ground and streams had become frozen. The skin was seen by the writer. It was lightly furred, indicating that perhaps the animal had been in captivity, but inquiries in the locality and an item placed in local newspapers failed to locate any person who had had one of the animals as a pet. I can find no other record for the taking of this animal in Vermont, which is far north of its usual range.—George L. Kirk, *Rutland, Vermont.*

OPOSSUM CARRIES LEAVES WITH ITS TAIL

A number of years ago five living opossums were sent to the Field Museum of Natural History from southern Illinois. In the lot were one nearly grown female and four young, not her own, about the size of large house rats. After arrival they were kept temporarily in a wire-covered barrel. The second night the large female literally "ate alive" one of the young, and afterwards forced her escape from the barrel. She had eaten the hind quarters of the unfortunate youngster without first killing him, as attested by his contorted carcass and awful facial grimace when found cold and stiff next day.

After this episode I kept only one young opossum alive, in order to make a few studies from life of so curious a mammal. When the fall days began to grow cold I gave this fellow a thick carpet of autumn leaves in his box cage. Though he ate heartily of meat scraps, fruits, and vegetables, he was not contented. When not sound asleep in his favorite corner he pounded solemnly around and around his cage like a wild tiger, with a funny preoccupied look on his grinning face. One morning when I glanced into his cage I was surprised to see him pacing around his beat with a large bunch of leaves tightly rolled up in his long, prehensile tail. He carried this bundle so long, around and around in tireless pace, that I left him without learning the object of his action. Later he repeated

this carrying of a bundle of leaves in his tail a number of times. I noticed that he had made a half hearted attempt to build a nest in one corner, but had abandoned the idea and slept anywhere that he happened to be when drowsiness overcame him.

Opossums of course use their tails with agility in climbing, but I have never seen a note in mammalian history on the use of the tail as a carrier of material of any kind, so thought this account might prove of interest to readers of the Journal. The accompanying sketch shows accurately the manner in which the tail was employed in carrying bundles of leaves.—Leon L. Pray, *Field Museum of Natural History, Chicago.*

NOTES ON THE EUROPEAN HEDGEHOG

Extracts from my journal, written at Ultuna, Sweden, 1898: *August 4.* A member of the faculty of the Agricultural College, located here, informed me that every night a hedgehog (*Erinaceus europæus*) was seen to leave a thicket near the campus, and make for the shrubbery along a small stream, where it fed during the night. We went out that evening to watch for it, and had about given up seeing it, when we heard a woman talking and found her in earnest conversation with the hedgehog. It stood a few feet away gazing at her, but on seeing us turned and ran under a building where it was captured. It did not roll up until I had handled it roughly. I was told that these animals fed on mice, berries, and scraps thrown from the kitchen.

August 5. Among the twenty-five specimens caught today, were two *Erinaceus.* One was taken in a steel trap baited with bread and set by the side of an out-building; the other in a Schuyler rat trap set in a barn and baited with rolled oats.

August 11. Last night I caught another *Erinaceus* in a steel trap baited with rolled oats. . . . . A half-grown hedgehog that I keep in my room shows displeasure, when disturbed, by sniffing through his nose and making a noise in his throat that sounds like heavy heart-throbs. Occasionally he shakes himself, ratting his spines. When placed on a couch, he shows fear of falling, creeps cautiously to the side, lies prone, and peeps over the edge. I offered him bread and boiled potatoes, and, though he accepted them, he took a piece of raw meat much quicker. At first he started to roll up, but, on scenting the meat, uncoiled, accepted and ate it very slowly, all the time grating his teeth. He does not use his front feet while eating. Whenever I handle him he rolls up so tightly that it is difficult to find the opening. He does not attempt to bite [he did later however] even when I catch him before he is tightly closed and tickle his belly. I have just induced him to walk six inches to my hand and take a piece of raw meat from my fingers.

August 12. My pet *Erinaceus* is very interesting. He eats the bodies of both *Sorex* and *Neomys,* chewing the meat fine and eating slowly. It took him eight minutes to eat a half grown *Microtus.* Last evening I knocked from a table, and broke, a glass candlestick; and during the night the hedgehog awakened me by rolling one of the pieces about the floor. Then he began scratching on the side of the chamber vessel and I chased him away, but he returned and I had to remove the vessel in order to sleep. He is very active. I can call him from

the far side of the room by tapping on the carpet with my fingers and when he comes up, possibly with the expectation of being fed, he shows his displeasure by snuffing and butting at my hand. Whenever I try to pick him up he hugs the floor, sniffs, and butts sidewise at my hand. A bowl of drinking water on the floor he tipped over on its side, and then, putting his nose against it, rolled it about the room; went away, but came back and repeated the performance several times. These animals seem to be incapable of digging. I have had six of them for over a week confined in a wire enclosure built on the ground and they have made only feeble attempts to dig out.

August 15. Notwithstanding that I have been told repeatedly that hedgehogs eat berries greedily, I have not succeeded in coaxing my pet to do so, although there has been a handful each of strawberries, huckleberries, and squawberries in a corner of the room for two days. When he sleeps, unless he is confined in a small space, he does not roll up, but lies on his side half coiled like a dog.

August 17. My little *Erinaceus* spent the day—dark and rainy—running about the room. He stands high and at any sudden noise, such as the slamming of the door or dropping of a book, jumps nervously. At the first sign of danger he squats, ducks his head, and throws the spines on his head forward preparatory to rolling up. Several times he has bitten my fingers but it is never more than a hard pinch. I gave him a small *Microtus* and two *Sorex* and in eating the last *Sorex* it took him exactly sixteen and a half minutes. I have just finished making up the skins of five adult animals of this species. Adhering to the skin on the back, and between the fat on the body and the skin, is a sheet of fleshy muscle an eighth of an inch in thickness which terminates abruptly and is much thicker at its outer edge. This fleshy muscle, covering the area occupied by the spines, is similar to that found on the skin of a porcupine and probably is for the purpose of erecting the spines. A broad and much thicker band of muscle encircles the entire body at a point where the spines and the hair unite. It passes over the top of the head and acts as a puckering string when the animal curls up. To do this, he simply ducks his head, humps his back, and contracts the muscle band. By placing my fingers against his belly and tickling until he curls up, I can distinctly feel this band. Last night my pet managed to climp up on the bed and wakened me by sniffing and butting sidewise against my cheek.—J. Alden Loring, *Owego, N. Y.*

SHREWS AND WEASELS

It is pretty generally known that most animals, both wild and domestic, will not eat the short-tailed shrew (*Blarina*) and the distaste for the little mammal seems to be shared by the weasel. Is the aversion mutual?

In December the writer had a trap set for weasels under a brushy fence. The place was infested with blarinas and they were attracted to the rabbit bait and caught regularly. A weasel will take almost any kind of bait in the form of flesh, but tracks in the snow showed that if a Bonaparte weasel approached the trap when it held a shrew, it kept at a distance of four inches and refused to touch the bait. The *Blarina* was removed and the next morning the trap held a weasel. The snow indicated that blarinas had run back and forth under the brush several times but the weasel was untouched. White-footed mice and field mice (*Peromyscus* and *Microtus*), which had previously been caught in the trap, were almost entirely consumed by the shrews.—George L. Kirk, *Rutland, Vermont.*

THE HOG-NOSED SKUNK (CONEPATUS) IN COLORADO

The middle of December, 1920, Mr. C. E. Aiken of Colorado Springs, Colorado, showed me the skin and skull of a skunk which had been brought to him for mounting, and which was at once recognized as a species of *Conepatus*, a genus hitherto unreported from Colorado. This specimen was taken by Mr. Sam. Keaton near his ranch on Little Fountain Creek, some twelve miles southwesterly from Colorado Springs, at the edge of the foothills. Mr. Keaton has lived on this place from his boyhood, since 1873, and while he has trapped *Mephitis* and *Spilogale* there, he had never before seen a skunk like this, and recognizing it as something new, was afraid to shoot it for fear of injuring it too much, therefore threw stones at it, chased it, and finally threw himself down upon the animal and strangled it with his hands. This was some time between the first and tenth of December, 1920.

Mr. Aiken, who has kindly consented to my publishing this record, gave me permission to send the specimen to the Biological Survey for identification, and I received two letters from Mr. E. W. Nelson, chief of the Survey, concerning it. In one he remarks that the record from a locality so far north is a very interesting and surprising one, the most northern one in the Biological Survey files being from the vicinity of Albuquerque, New Mexico. In the second letter, written a few days later, after the specimen had been compared with material in the Biological Survey collection, he states that the animal is a young one, and is provisionally referred to *Conepatus mesoleucus mearnsi* Merriam.

If the specimen is a young one, and it certainly appears to be small, it would seem possible that a litter may have been raised in that locality and that there may be more there. And this brings up the question as to whether this, or its family, if there is a family, is merely a straggler, or whether the hog-nosed skunk is extending its range to the northward and until now has escaped notice. The locality is somewhere about the boundary between the Transition and Upper Sonoran zones.—EDWARD R. WARREN, *Colorado Springs, Colo.*

THE ELEPHANT SEAL OFF SANTA CRUZ ISLAND, CALIFORNIA

I was recently asked to identify a strange creature that had been seen by one of the fishermen plying out of the harbor of San Diego. The man stated that his boat was about five miles southwest of the south end of Santa Cruz Island when he encountered a large school of herring, which were followed by a number of whales and the usual school of albicore. As the boat arrived on the scene a strangely weird animal appeared from the depths, rearing its head a yard or more above the waves, only a hundred feet from the fishermen. After staring at them for a moment it sank with a splash and reappeared some hundred yards distant. The description was so accurate that there is very little doubt but the animal was a large male elephant seal, *Mirounga angustirostris*. This record would seem to give credence to a report that came to me about a year ago, of a seal of this species being shot off Santa Catalina Island.

Fifty years ago the elephant seal was abundant on the Channel Islands and as far south on the Mexican coast as about 26° north lat. Constant persecution reduced its numbers, until twenty years later it was considered nearly, if not

quite extinct. A small colony, living on Guadaloupe Island, escaped destruction, though raided on several occasions, and from late reports there would seem to be a few scattered remnants to remind us of this once abundant species.—A. W. Anthony, *Nat. Hist. Museum, Balboa Park, San Diego, California.*

MICE AND CHIPMUNKS HELP RESTOCK FORESTS

Mice and chipmunks are helping to reestablish the forests of Oregon and Washington, according to officials of the Forest Service, United States Department of Agriculture. Studies made by J. V. Hofmann, director of the Wind River Forest Experiment Station at Stabler, Washington, have shown that a large part of the young fir growth coming in on burned or logged areas in these States is not wholly due to seeding by occasional trees which are left, but in part to seed buried by small rodents beneath the duff of the forest floor.

In the West mice and other rodents are usually condemned as workers of evil in the forest. They often do considerable damage to food supplies, and their appetite for pine and fir seed is chiefly responsible for the abandonment of attempts to reforest burned-over and waste areas by direct seeding methods. Sometimes, however, the work of these little animals is beneficial.

"In the Douglas fir region," says Mr. Hofmann, "the forests produce a heavy seed crop every two or three years. Rodents collect the seed from the cones in large quantities and bury them just beneath the surface of the soil. Part of the seed thus stored away is eaten, but snow and soil movement often cover many of the hoards so that they are never found. When logging operations open up the stand, these seed germinate and produce a new stand of little trees."

The Wind River Experiment Station is but one of several similar establishments maintained by the Government in the national forests for solving forestry problems. In this particular case many thousands of dollars have been saved annually to western lumbermen through the assistance of rodents in restocking cut-over lands. This is one example of the value of the experiments being carried on by these stations, which are so important to the perpetuation of our forests and dependent industries.—U. S. Department of Agriculture Press Service, *Washington, D. C.*

A RECENT MIGRATION OF THE GRAY SQUIRREL IN WISCONSIN

In a previous paper I have noted a migration of northern gray squirrels (*Sciurus carolinensis leucotis*) across the Mississippi River from Wisconsin into Minnesota during the autumn of 1905. The migration may have been caused by a shortage of nuts on the Wisconsin side of the river (Bull. Wisconsin Nat. Hist. Soc., vol. 8, p. 87, 1910).

On a field trip for the United States Biological Survey during the past summer (1920), I had occasion to visit Pepin, Wisconsin. While there, Mr. Broach, a reputable citizen of that village, told me about a migration of gray squirrels which occurred early in the fall of either 1914 or 1915. The squirrels came from the hills 2 or more miles back of Pepin, followed a point out into the foot of Lake Pepin, and there swam a distance of about $\frac{1}{4}$ mile across the Mississippi River to the Minnesota shore. Mr. Broach would give no estimate of the number

of squirrels but said "there was a continuous movement, and possibly an average of two entering and two emerging from the water every few minutes for about a day." Mr. Broach stated that there was no food shortage of the Wisconsin side of the river, there being an abundant crop of acorns, nuts, and corn.—Hartley H. T. Jackson, *U. S. Biological Survey, Washington, D. C.*

CÆSARIAN OPERATION ON LEPUS ALLENI, AND NOTES ON THE YOUNG

On March 13, 1920, a female *Lepus alleni* was shot on the Santa Rita Range Reserve, south of Tucson, Arizona, for breeding record. When the body was opened, three very large foetuses were discovered, and after a little hesitation it was decided to open the uterus and note the condition more definitely. No sooner was this done with the first than on the freeing of the head the young animal began to breathe precisely as if normally born. After a little further hesitation, which nearly resulted fatally for the third youngster, it was further decided to release all of them and see whether they would survive. This was done as quickly as possible, with the result that in a few moments all three were lying across the warm body of the mother in the sunshine, breathing normally; and in a surprisingly short time attempting to find a nipple for nursing. In actual fact, the first one released from the amnion was attempting to suckle before the third one was fully freed. No bleeding whatever occurred when the umbilical cords were cut although this was done immediately on releasing them from the membranes, which fact would indicate that they must have been normally born within a very short time, probably within the ensuing twenty-four hours. As the eyes were open from the first, there can be no doubt that they are open at normal birth in this species.

The sun was bright and warm, the hour being 10.00 a.m., and there was scarcely a perceptible breeze, so that no difficulty was experienced in keeping the diminutive jacks warm until they were thoroughly dry. In the meantime they kept close up against the now cooling body of the mother, whose nipples they repeatedly sucked upon. However they evidently secured no milk, as none would hold to a teat for more than a few seconds.

Some photographs were taken of them alongside the body of the mother, after which they were wrapped carefully and taken to camp on the seat of the car. Here for a few hours they were kept warm and contented in the sunshine and were fed a small amount of milk from a spoon. During the afternoon they were taken on a forty mile trip to Tucson, and established in a box with plenty of old woolen blanket for warmth. After several attempts to feed them in various ways an ordinary pipette was found to be most satisfactory. About five pipettes full of warm cow's milk, amounting to from 8 to 10 cc., constituted a feed during the first day, and three feedings per day were decided upon after some observation. The second day condensed milk, diluted with an equal quantity of water, was substituted for fresh cow's milk.

Owing to the fact that very little exposure would chill the little animals, measurements were not taken on the first days of life. All were weighed however, and the weights were 108, 103.5, and 90 grams, respectively, at noon of the day they were taken. In spite of every care and the use of the same food, the smallest did not thrive from the first as the others appeared to do. It ate as much

but was not so active, and did not make the gain in weight and activity which was at first noticeable in the others. By March 18, the fifth day, it would no longer take food to any extent. The larger ones by this time would drink avidly about 15–20 cc. at a feeding. In fact this small individual was so nearly dead on the evening of this day as to justify killing it.

During the next two or three days, first one and then the other of the remaining two became ill, and in spite of all attempts to save them with dietary variations the second died at the close of the eighth day, and the third on the tenth day. A mother cat with a kitten the same age as the young rabbits was located at a neighbor's the seventh day and the two rabbit babies were offered to her and at once accepted, but this proved to be too late to save either of them. It was felt that had she been discovered early in the week the rabbits might have been successfully reared, and it is hoped to secure again at some future date the young of this species for observation throughout the growth period, and to secure a cat as foster mother.

On March 18th the remaining two were measured as accurately as possible with results as follows:

	Length	*Tail*	*Foot*	*Ear*
No. 1	150 mm.	8.0 mm.	40 mm.	37 mm.
No. 2	150 mm.	8.5 mm.	45 mm.	40 mm.

A marked tendency to nocturnal habits was noted on the second day of life, and this became more marked in succeeding days. This was evidenced in the fact that not one of the three would accept milk at noon, after a morning feeding. However, by 4.30 or 5.00 p.m. food was readily accepted, and again at night from 9.30 to 10.30. Indeed the alertness and activity of all was much more marked at this hour than during any of the daylight hours, which latter were spent in sleep. Even when effort was made little activity could be aroused, and no interest in food was ever shown at midday. In the night, however, as soon as coverings were removed the young rabbits would quickly rouse up, raise heads, erect the ears, and crawl or hop about and search for food. On the night of March 17 when a light was switched on at a few minutes after ten o'clock, I was much surprised to see the two larger ones emerge from the coverings with ears erect, hop to the side of the box nearest me, and make an effort to climb out. This was in fact easily accomplished by the first, which could barely reach the top edge of the small box from the blanket on which it stood.

The incisor teeth of these specimens were so well developed that bits of lettuce, apple and other fresh succulent vegetables were offered them, but no interest whatever was manifested in such foods. It is a source of regret that the desirability of saving the skulls was overlooked until too late. The pelage was well developed, the young being so fully clothed from the first in short fur as to give no impression of the semi-nakedness seen in so many young mammals born with partially developed pelage.

In coloration the young were typical *alleni* as to the ears, with their posterior edges of white, and as to general ground color, except that they were perhaps a trifle darker than the average adult. Each had a small but distinct white spot in the center of the forehead, which is not present in the adult. The white of the side and belly was never drawn up on the back and side during the few days

the young were under observation, a movement so characteristic of the frightened adult as to have caused this species to be known as the "antelope jack-rabbit." —Chas. T. Vorhies, *University of Arizona, Tucson, Ariz.*

DATES OF SHEDDING OF HORNS IN YELLOWSTONE PARK

During the season of 1919–1920 the dates of shedding of horns by wild antelope, elk, and deer in the Yellowstone National Park, Wyoming, were as follows: Prong-horn antelope, October 20 to November 25; elk, March 19 to May 4; white-tailed deer, January 15 to February 20; and mule deer, January 6 to March 25. Horns from many weak and decrepit elk and deer fell much earlier than usual, and that is the reason for the early dates above. The lack of vigor of these animals was due, of course, to the hard winter and want of suitable food.—M. P. Skinner, *Yellowstone National Park, Wyoming.*

SHED HORNS OF THE AMERICAN ANTELOPE

The following notes were brought out by the article on the horns of the antelope in the May, 1920, Journal of Mammalogy from the pen of Mr. Vernon Bailey and were sent to him as a private letter. It has been suggested that they are of enough interest to be printed in the Journal. What they tell has been known to certain observers for many years, but has perhaps not been published.

Thirty or forty years ago, when antelope in their range were enormously abundant, shed horn sheaths were often seen on the prairie. Usually, they were in bad condition. Many years ago, at my request, Capt. L. H. North made an experiment which showed that these horn sheaths offer little resistance to the weather and are very perishable. I think it was in December in the late '70s—probably 1878—that he killed, in western Nebraska, an antelope, from whose head as it fell both horn sheaths dropped off. Mr. North put the sheaths together, and noted the spot, and now and then through the winter in his range riding looked at the horns. In the early summer they began to split and crack, and in late August or September following, when we last looked at them, they had practically disappeared, and there remained only a few long black splinters of horn. The hard tips were recognizable when carefully looked for, but no one who was passing by on foot or on horseback would have noticed that there was anything lying on the ground. In those days, food was far more abundant on the prairie than of late years. Even then no doubt coyotes may have gnawed the antelope horns, but many of them were left untouched.

Since in those early days the antelope was the most abundant and most universally distributed large mammal on the plains, it was one of those most frequently killed for food. When a buck antelope was killed, late in the season, it often happened that if one took hold of the horn to turn the head so as to cut the animal's throat, the horn sheath slipped off in the hand. The new horn below was always hard at the tip, but for only a short distance back from the end. It was covered almost to the tip with long growing hairs, somewhat as shown in Mr. Bailey's figure 1, plate 8, in the Journal of Mammalogy. The hard black end of the sheath was very short and the hair clothed skin extended almost up to the end of the sheath.

As time went on, the black, hard tip of the horn extended further and further down toward the head—the hair apparently coalescing to form this black horn—and the active growing hairy skin surface toward the base of the horn became more and more reduced in vertical length.

We know little, as has been said, about the process of shedding and renewing these horn sheaths; but for many years I have believed that at the close of the rutting season, say early in October, the periosteum of the horn core becomes more active and thicker, takes on the character of the body skin, hairs begin to grow from it rapidly, and as these hairs grow the old horn sheath is pushed away from the core and up and off the sheath. The result of this is that by late fall or winter the whole horn sheath is loosened and ready to drop off.

In old times hunters trying to save their antelope heads occasionally carried the skulls tied—often by the horns—to the wagon bows or wagon axles, and sometimes lost skulls or horn sheaths or both, because if the periosteum of the horn core began to decay, the sheath slipped off and was lost. Even at the period of the rut, if the sheath were separated from the horn core, fine hairs were seen growing from the skin on the horn core.

The season for the shedding of the horn sheaths is late fall or early winter, the time running from November 15 to the end of December.

The rut takes place two months earlier—during September—and at this time there is much fighting among the males, though I have never seen anything like the account given by Audubon, which of course he received from others. Often the fighting does not become an actual battle, but one of the males rushes at another which turns and runs, to be pursued by the stronger for a mile or more.

Sometimes, however, there is actual contact and the antelope come together, head on, with a certain amount of violence, and then push hard for two or three minutes, when the weaker, by a swift sidewise bound and turn, saves himself from the horns of the stronger and runs. It is possible that the shock of the horns coming together might have a tendency to loosen the horn sheaths.—Geo. Bird Grinnell, *New York City.*

FIELD SUGGESTIONS

For one reason or another, it is sometimes advisable while on a field trip to carry small mammals "flat" instead of making up the skins on the spot. If the following suggestions are adopted the final preparation of the specimens will be materially facilitated. Leave in all the leg bones, for it is sometimes difficult to relax the feet to the extent where wires can be inserted. Leave the specimens inside out and then prepare a small cardboard form of the shape used for stretching cased furs, over which the skin should be drawn, care being taken that the ears are not left pointing forward. Cut a notch in each side of the form so that the posterior edges of the skin will be caught by them and prevented from shrinking unduly. This cardboard may be cut an inch longer than necessary and the data written upon it. Finally, the usual tail wire should be wound with cotton, dipped in arsenic, inserted, and then bent back over the skin, so the tail will be out of the way. Unless this is done it is often impossible to relax the tail sufficiently to allow a wire to be inserted without causing the hair to slip. I have sometimes worked for an hour over an especially refractory tail.—A. Brazier Howell, *Pasadena, California.*

RECENT LITERATURE

Gregory, William K. Studies in Comparative Myology and Osteology: No. IV.—A Review of the Evolution of the Lacrymal Bone of Vertebrates with Special Reference to that of Mammals. Bull. Amer. Mus. Nat. Hist., vol. 42, pp. 95–263; 196 text figs. and 1 plate. December 4, 1920.

This important contribution to the literature of mammals "has partly grown out of a difference of opinion between Dr. J. L. Wortman" and the author "concerning the probable course of evolution of the lacrymal bone in Primates." In the introduction is a "Synopsis of the classification of the vertebrates adopted in this work," including the lower vertebrates, fishes, amphibians, reptiles, birds, and mammals. "The present classification of the mammalia has grown out of the classification adopted in 'The Orders of Mammals' (1910, Bull. Amer. Mus. Nat. Hist., XXVII) and is intended to reflect the chief advances of the last decade in this subject." The arrangement of the orders in this new classification is as follows; the extinct groups have been marked † (by the reviewer).

†Protodonta
Monotremata
†Triconodonta
†Multituberculata (Allotheria)
Marsupialia
†Trituberculata
Insectivora (Centetoidea, Soricoidei, Erinaceoidei, Pantolestoidei)
†Tillodontia
Carnivora (including Pinnipedia)
Cetacea
Artiodactyla
†Amblypoda
†Embrithopoda
†Pyrotheria
Proboscidea
Sirenia
†Condylarthra
Tubulidentata
†Litopterna
†Notoungulata
Hyracoidea
Perissodactyla
Edentata
Rodentia
Lagomorpha
Dermoptera
Chiroptera
Menotyphla (the tupaioid "insectivores")
Primates

Following other introductory matter is an account of the lacrymal region in mammals, with numerous drawings to illustrate the text, and with much interesting discussion as to the origin of various groups. In his "Summary of the evolution of the lacrymal bone," the author says that the present study "lends strong support to the so-called 'Cuvierian concept:' namely, that the lacrymal of mammals is the homologue of the lacrymal of the Crocodilia, as named by most authors up to the time of Gaupp and Jaekel, who, on the contrary, held that the Cuvierian concept was erroneous and that the lacrymal of mammals had been derived from the so-called prefrontal of reptiles."

The last section of this work, "The lacrymal problem in its phyletic and taxonomic aspects: a phylogenetic review of the vertebrates," is of particular interest, and Doctor Gregory at the outset remarks that "the elements of the lacrymal complex being relatively few in number, it is not surprising to find more or less similar combinations sometimes occurring independently in widely different groups, so that in such cases a similarity in the pattern of the lacrymal region does

not denote near relationship." The unhappy results obtained by Knottnerus-Meyer in his attempts to classify ungulates by the characters of the lacrymal bones alone, might have been mentioned in this connection as an example of the dangers to be encountered in the complete reliance on any one part of the structure of an animal as a sure guide to its affinity.

—*N. Hollister.*

Matschie, Paul. NEUE ERGEBNISSE DER SCHIMPANSENFORSCHUNG. Zeitschr. f. Ethnol., vol. 51, pp. 62–82. 1919.

This paper is based upon the author's recent studies on 322 skulls and 159 skins of the chimpanzee. In the critique of the features that have been claimed in the literature to distinguish the chimpanzee from other apes many interesting statements are found: the length of the arm varies to a great extent in the different species of chimpanzee; there are forms in which the arm is as long as in many orang-utans. The outer ear of the chimpanzee is said to be larger than that of the gorilla. This rule, however, has many exceptions; there are chimpanzees whose ears are only 40 mm. long, and in Kamerun there is a gorilla with ears at least 42 mm. in length even in the young animal. The crista sagittalis on the skull, often held to be typical for *Gorilla*, is missing in a great many females of this ape and is found among the chimpanzees in the Tschego and some species of the Congo and Ogowe regions. The nasal bones, which according to Keith, reach farther down in the gorilla than in the chimpanzee, are at times of greater relative length in the latter than in the former. The author finds that the gorilla is distinguished from the chimpanzee by the fact that the nasalia are more than twice as broad at their lower as at their upper ends, and also by the second last upper molar, which is at least 13 mm. in breadth and 12 mm. in length, while in the chimpanzee it is at most 12 mm. in breadth and 10 mm. in length.

A good deal of space is devoted to the description of many different species and races of chimpanzee, among which the author proposes some new ones, e.g., *Anthropopithecus schneideri* and *A. papio*.

—*A. H. Schultz.*

Eggeling, H. INWIEWEIT IST DER WURMFORTSATZ AM MENSCHLICHEN BLINDDARM EIN RUDIMENTÄRES GEBILDE? Anatom. Anz., vol. 53, pp. 401–428. 1920.

The largest part of this paper is devoted to a description of the caecum and, where it is to be found, of the appendix in primates. The latter is present in apes and in *Stenops* and *Chiromys* of the Prosimiæ; it is missing in catarrhine as well as platyrrhine monkeys. The paper contains interesting extensive tables on the length of the different regions of the intestinal tract of primates.

—*A. H. Schultz.*

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——— The mammals of Warren Woods, Berrien County, Michigan. Occasional papers Mus. Zool. Univ. Michigan, no. 86, 20 pp., 2 plates, June 24, 1920.

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Gregory, William K. Facts and theories of evolution, with special reference to the origin of man. Dental Cosmos, pp. 1–19 (of reprint). March, 1920. (Lecture delivered before the annual meeting of the Eastern Association of Graduates of the Angle School of Orthodontia, New York City, May 5 and 6, 1919.)

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——— A micrological investigation of the hair structure of the Monotremata. Amer. Journ. Anat., vol. 27, pp. 463–495, September, 1920.

——— Structural characteristics of the hair of mammals. Amer. Nat., vol. 54, pp. 496–523, 199 figures. November–December (December 6), 1920.

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Kerr's *Cervus cuguapara,* is applied to specimens from Manaos. The new name *Mazama simplicicornis* var. *kosertzi* occurs on three plates showing a skull from Rio Grande do Sul. A colored plate shows the type specimen of Natterer's *Nanelaphus nambi* from the original in the Vienna museum.)

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——— Two new Muridæ discovered in Paraguay by the Marquis de Wavrin. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 177–179. February, 1921. (*Oryzomys wavrini* and *Akodon toba*, new species from the Northern Chaco.)

——— A new mountain vizcacha (*Lagidium*) from N. W. Patagonia. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 179–181. February, 1921. (Describes *Lagidium boxi* from the upper Rio Negro, Patagonia.)

——— A new monkey and a new squirrel from the Middle Mekong, on the eastern frontier of Siam. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 181–183. February, 1921. (*Pithecus laotum* and *Dremomys rufigenis laomache* are described as new.)

——— New *Rhipidomys*, *Akodon*, *Ctenomys*, and *Marmosa* from the Sierra Santa Barbara, S. E. Jujuy. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 183–187. February, 1921. (*Rhipidomys austrinus*, *Akodon sylvanus*, *Ctenomys budini barbarus*, and *Marmosa elegans sponsoria* are new forms from Argentina.)

Thomas, Oldfield, and Herbert C. Robinson. Some new insular squirrels of the *Callosciurus caniceps-concolor* group from peninsular Siam. Ann. and Mag. Nat. Hist., ser. 9, vol. 7. pp. 118–123. January, 1921. (Nine new forms of *Callosciurus*.)

Trouessart, E.-L. La pluralité des espèces de gorille. Bull. Mus. d'Hist. nat., pp. 102–108, 191–196 (1–13 of reprint), 9 figs. 1920. (Material in the Paris museum shows that two distinct species of gorilla inhabit West Africa; the *Gorilla beringei mikenensis* of Lönnberg, from the lake region, is regarded as representing a third very distinct species.)

——— *L'Echinoprocta rufescens* (Hystricidaé), décrit par Gray en 1865, retrouvé en Colombie, pres de Bogotâ. Bull. Mus. d'Hist nat., pp. 448–453, 3 figs. 1920. (Revised diagnoses of genus and species.)

Troughton, Ellis Le G. Notes on Australian mammals. No. 1. Rec. Australian Mus., vol. 13, no. 3, pp. 118–122, figs. 1–6. December 4, 1920. (*Chalinolobus morio, Eptesicus pumilus, Epimys assimilis.*)

Willey, A. A question of bibliography. Science, n. s., vol. 52, pp. 608–609. December 24, 1920. (Asks for information as to what "Mr. Lockhart" is quoted in Coues' Fur-bearing Animals as authority for observation on habits of the wolverine.)

THE NORTHERN CALIFORNIA SECTION OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The Northern California Section of the American Society of Mammalogists was started on January 8, 1920, when, at the suggestion of Dr. Joseph Grinnell, a meeting of persons interested in the study of mammals was held at the California Museum of Vertebrate Zoology in Berkeley. Organization was effected at that meeting and affiliation with the main Society was accomplished the following month. During the year 1920 nine meetings were held, there being a recess over the summer months when a number of the members were absent on field trips. The attendance has varied from five to fifteen but the degree of interest shown is far above that indicated by the attendance. Meetings of other scientific organizations in the San Francisco Bay region have made it impossible for all the local members to be present at each meeting of the section and absence on field trips has further interfered with attendance.

The field of interest has been quite wide although greater emphasis has been laid upon the life histories of mammals than upon any other one subject. The programs of the several meetings were as follows:

January 8, J. Grinnell, On kangaroo rats; J. Dixon, Trapping and trappers in central and southern California.

February 5, A. B. Howell, The California mastiff bat; Some Californian experiences with bat roosts (see this Journal, 1920, pp. 111–117; pp. 169-177).

March 4, Dane Coolidge, Collecting mammals in Italy and France in 1900.

April 1, J. Dixon, The golden beaver at Snelling, California.

May 6, Prof. C. A. Kofoid, Experiences with the wild mammals of southwestern British India.

August 26, Prof. J. S. Kingsley, Some reminiscences of vertebrate zoologists.

September 16, Symposium on the status of deer in the central coast counties of California.

October 28, "Book evening" at the University of California Library.

December 9, Dr. T. T. Waterman, Indian legends relating to western mammals.

One meeting during the year, that on September 16, was held in San Francisco, and one at the University Library, while the remainder were held at the Museum of Vertebrate Zoology. The greater part of the local membership resides in Berkeley and so most of the meetings are held there, but in fairness to those living in San Francisco one or more meetings each year will be held in that city. The first Thursday of each month has been chosen as the regular meeting night and this plan will not be changed except in special circumstances. The organization has been maintained in as simple a manner as possible, the conduct of the meetings is quite informal, and the only levy during the past year was for the printing of meeting notices.

Those in attendance during the past year feel that much good has resulted from the Section and we would strongly urge that members of the Society in other localities combine in like manner and establish their own Sections.

It is the desire of the Section that members of the Society at large from other parts of the country, when in the Bay region, will get in touch with the Section and attend its meetings.—Tracy I. Storer, Secretary, *Museum of Vertebrate Zoology, Berkeley, California.*

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UNIT CHARACTER VARIATION IN RODENTS[1]

By L. C. Dunn

Recent progress in the study of the inheritance of coat colors in several species of rodents has revealed a rather striking similarity in the variations which have arisen in distinct species of that order. This similarity is not only a matter of appearance, which is familiar to all students of mammals, but extends as well to the manner of inheritance, and most recently has been found to characterize the localization of the determinants or genes for similar variations in two species. Such identity of cause of the same variation in two or more species indicates that such variations are homologous, and that the species which give rise to them have a relationship of a somewhat different and more intimate kind than that implied in the theory of relationship by common descent.

Before detailing the conditions in the species of rodents which have been studied, some explanation of the evidence and reasoning which underlie the localization of genes is due to the general reader. It is probably recognized by all students of biology that heritable variations arising generally by mutation are transmitted to the offspring in accordance with certain definite rules, known familiarly as Mendel's laws of inheritance. The chief of these laws states that heritable characters are transmitted as discrete units which segregate in the formation of the germ cells. A second principle asserts that the segre-

[1] In this paper, which is to regarded as a cursory survey leading to a consideration of one or two special points rather than as an authoritative exposition of variation in rodents, I have not felt it essential to furnish a detailed bibliography. The necessary references may be found in Castle (1920) and Morgan (1919) as noted in the bibliography, and an excellent survey in Wright (1917), which also considers the physiological and chemical aspects of color variation and inheritance.

gation of the units is independent, resulting in a random distribution of the characters of the parents among their gametes, such that when two units are involved the chances are equal that they will go together or separately. The first principle probably applies to all inheritance. Evidence has been brought forward to show that the factors or genes which represent the visible characters are not discrete but variable, and capable of change by selection, but this evidence has now been found to indicate not variability but plurality of units. The second principle still applies to most cases of inheritance but has been modified by the finding that two or more characters may not always be distributed independently but when entering a cross together may tend to stay together, and when entering a cross separately may tend to remain separate (in different individuals) in inheritance. This peculiarity was first remarked by Bateson (1906) in the case of the inheritance of flower color and pollen shape in sweet peas. In his experiments purple flower (as opposed to red) and long pollen (as opposed to round) appeared to be associated or coupled in crosses so that a marked distortion was evident in the second generation ratio of 9:3:3:1 expected on the usual hypothesis of independent assortment, in favor of the classes (purple-long and red-round) representing the grandparental combinations of these characters. The opposite phenomenon was noted and named repulsion. Later, Morgan in 1910 found the same phenomena while studying inheritance of certain characters which had arisen by mutation in the vinegar fly (*Drosophila melanogaster*). He conceived these two exceptions to Mendel's principle of independent assortment as two aspects of a single phenomenon which he termed *Linkage* or associated inheritance.

The interpretation of these events has constituted one of the great advances of biological science. Sutton, in 1902, suggested that the marked parallelism between the discreteness and assortment of unit characters and the behavior of the chromosomes might be due to the residence in the chromosomes of the determinants or genes representing unit characters. Immediately after Bateson's announcement of coupling, Locke (1906) pointed out the similarity between this new mode of inheritance and the results which might be expected if the coupled characters were determined in one chromosome. The development of this hypothesis, its proof and very important extension and generalization, have been the work of the American biologist T. H. Morgan, and of research workers associated with him, assisted more recently by data gathered by geneticists and cytologists working on many

species of plants and animals. There has resulted from this work the elaboration of the chromosome theory of heredity, for the details of which, and the supporting evidence, the interested reader must be referred to the original works, especially as summarized in two publications of Morgan and his co-workers (1915 and 1919).

For our purpose it is sufficient to note in brief that the theory supposes that the differential representatives of heritable characters are located in the nuclear material of the egg and sperm cells, more precisely in those remarkably constant and individual organizations of chromatin known as chromosomes, which appear at the time of cell division and which probably retain their individuality even in the resting stages of the nucleus. Of the evidence it must be observed that the interpretation and proof of the theory rest entirely on the study of linkage, or associated inheritance. This phenomenon is observed in the tendency which characters exhibit of remaining through several generations in their original combinations, resulting in an alteration of the expected Mendelian ratios based on independent assortment. This tendency may be absolute, in which case linkage is said to be complete. More often it is partial, that is, characters originally associated may separate in a certain proportion of instances, or characters originally separate may become associated. This change in the relationships of genes is known as "crossing-over" and it provides a quantitative measure of the strength of the tendency toward association. In terms of the chromosome hypothesis it is interpreted as an interchange of parts and of the genes which the parts carry, between two members of a chromosome pair, so that two genes originally resident in one chromosome may come to lie in two chromosomes and may thence be distributed to separate gametes and exhibit their effects (unit characters) in different individuals. For any two characters the number of times crossing-over occurs is found to have a characteristic value and this value is stated as the percentage of times crossing-over occurs as evidenced by the frequency of individuals possessing the two characters in the new combination. One other importent aspect of these measurable breaks in linkage is that from the linkage strength may be inferred the proportional distance apart of linked genes. From cytological evidence crossing-over is supposed to take place between homologous chromosomes in the hybrid at the time when these chromosomes are intimately twisted one about the other. Breaks resulting in a separation of characters are then supposed on mere physical grounds to be more frequent between genes located far apart in the chromosomes

than between those located near together. The bulk of the evidence indicates that the loci of genes are on the same straight line in any chromosome. Numerical strength of linkage may then be a measure of the exact localization of the genes in the germ plasm, and it is to a consideration of this point that our whole discussion has led. For if the genes for unit characters can be thus localized, a direct comparison of species in which similar variations occur can be made on this point alone, even though the species cannot be crossed.

The study of localization of the genes for unit character variations is attended by numerous limitations. It can only be prosecuted through the experimental breeding of large numbers of organisms, exhibiting numerous variations. It is dependent even under these conditions on the occurrence of linkage, which is by no means common. It is a corollary of the location of genes in chromosomes, that the numbers of groups of linked genes be equal to the number of chromosome pairs present. Where the number of chromosomes is large, and the number of unit variations known is small, the chances are few that any two characters will be found to be localized in one chromosome pair. Even under such limitations, linked genes have been studied in several insects (chiefly *Drosophila*) and plants, and most recently in mammals. The general results of these studies have been to confirm the chromosome theory and to increase our knowledge of the localization of genes.

Correlative evidence has come from a brilliant series of cytological investigations on the germ cells of several organisms. It has been established that in the cells of each species are to be found a definite number of chromosomes, characteristic for the species. This number in germ cells is half the number found in the somatic cells, due to the intervention of reducing cell divisions. The chromosomes themselves are in general arranged in pairs of homologues in the somatic cells and in the primordial germ cells, one member of each pair having come from each parent, and this duality again becomes evidenced in the passage of one member of each pair into the germ cells which form the next generation. The individual chromosomes are sometimes recognizable by peculiarities of shape, etc. More often their constancy is of numbers only. These cytological results have been made possible only by a high development of technique and can provide even when greatly extended only correlative evidence on the localization of genes. The geneticist or cytologist no more expects to behold the gene of which his literature is full than the chemist hopes to see the atom of which he speaks with unabated glibness. The gene remains useful as a concept and a notation, doubly so now that it includes an idea of spatial definition.

The above is a somewhat pretentious introduction to a discussion which adds so little to the matters mentioned in the opening paragraph, and yet I hope it has not been without interest to those engaged in the study of mammalian variation and evolution. The facts and theories discussed are to have an important place in general biology, and one may perhaps wish to hear of progress in a field which has tended at times to shut itself off from its fellow branches, by the dialect it has been forced to use.

Perhaps the best way of presenting the evidence on unit variation in color in the Rodentia is to describe the appearance and genetic behavior of each of the principal variations with a short list of the species in which it has been studied, and of the species in which a variation of similar appearance has been reported.[2] Where the inheritance of a variation has not been determined by experimental breeding this fact is noted by an asterisk. This list makes no claim to completeness except in the cases of variations which have been studied experimentally. The rest of the variations have been reported as occurring in the wild or are represented by specimens in the Museum of Comparative Zoology at Harvard University, the Museum of the Boston Society of Natural History, or the American Museum of Natural History of New York. I am indebted to Dr. Glover M. Allen of the Boston Society of Natural History for help in gathering this part of the material, and for helpful suggestions and criticism of this paper.

All of the variations listed appear to have arisen, probably by mutation, from the primitive coat color of all rodents, the dull protective grey pattern known as "agouti." This color, which is actually a mosaic, is due to the presence of three pigments, black, brown and yellow, distributed uniformly over the dorsal surface of the animal. Each dorsal hair is characterized in general by an area of black next to the skin in which brown granules are mingled and generally masked by the black, followed by a band of diffuse yellow. The apex of the hair is typically black. The belly is always of a lighter shade than the dorsum, due to a lesser concentration of black pigment and a wider area of pale dusky yellow in the hairs. The "agouti" coat is seen in a typical form in the familiar wild house mouse (*Mus musculus*), the common rat of this country (*Rattus norvegicus*), etc. It characterizes the wild type forms of all the species included in the following list.

[2] This proceeding may be expected to lead to some errors since similarity of appearance is not always evidence of similarity in germinal constitution, but in the absence of breeding data we must use the only criterion available.

ALBINO

From this wild type distinct graded losses of pigment have taken place, the extreme of which is complete albinism, or entire absence of pigment, leaving the fur clear white and the eyes pink. The pinkness of the eye is due to the absence of pigment in the iris, which is typically colored by black or brown pigment granules, so that the blood in the capillaries on the retina is directly visible. This variation is to be sharply distinguished from "partial albinism," a term which has been applied, unwisely it now appears, to the occurrence of white spotting in animals whose eyes retain their full color. The color of the eyes is an important point of distinction between complete albinos and spotted animals. Cases of true albinism have been reported in nearly all the families of rodents. Data from only five of the commonest families are given here, the families being listed roughly in the order of their relationship from the more primitive to the more specialized.[3]

Leporidæ—	Oryctolagus cuniculus—European "rabbit."
Sciuridæ—	*Marmota monax—Woodchuck.
	*Sciurus hudsonicus—Northern red squirrel.[4]
	*Sciurus carolinensis leucotis—American gray squirrel.
	*Tamias striatus lysteri—Chipmunk.
Muridæ—	Mus musculus—House mouse.
	Rattus norvegicus—Common rat.
	*Microtus pennsylvanicus—Meadow vole.
	*Fiber zibethicus—Muskrat.
	Peromyscus leucopus noveboracensis—Deer mouse.
Hystricidæ—	*Erethizon dorsatum—Canada porcupine.
Caviidæ—	Cavia cobaya—Guinea-pig.

The inheritance of the albinism has been studied in the rabbit, the house mouse, the house rat, the deer mouse and the guinea-pig. In all of these it is due to a gene which acts as a Mendelian recessive to full color. At the same (albino) locus in the germ plasm have occurred other mutations. In the rat, a change in this locus has produced both

[3] I have followed the older order of classification which includes the Leporidæ in the Rodentia.

[4] Through the kindness of Professor Barrows of the Michigan Agricultural College and Prof. W. E. Castle of Harvard University the writer has learned of the capture of a pair of albino red squirrels by A. E. Secord, of Wheeler, Michigan. Breeding experiments to test the inheritance of this variation were to have been attempted but expense and pressure of other work have prevented the writer from undertaking the project. At last reports the squirrels were alive and for sale and it is hoped that they will come into possession of some interested person.

albino and its dominant allelomorph ruby-eyed dilute, in which the reduction of the melanic pigments is visible in the generally lighter tone of black, coupled with a complete absence of yellow. In the guinea-pig three graded variations have occurred: (1) *dilution*, resulting in a reduction of all pigments; (2) *ruby*, resulting in the absence of yellow, and the further reduction of black and brown in fur and eyes to very light shades (probably homologous with the ruby variation in rats); and (3) *Himalayan albinism*, which determines the absence of yellow and the restriction of black and brown to the extremities, ears, nose, feet, and rump, while the eyes are pink. These three conditions are distinct in appearance, do not blend in crosses and are all alternative allelomorphs with full color and with each other. No complete albinism is known in the guinea-pig. In the rabbit two changes have taken place: Himalayan albinism (probably homologous with the Himalayan albinism of guinea-pigs) and albinism. These are allelomorphic with full color and with each other; that is, crosses of full colored animals with albinos produce only full colored young and in the second generation only colored and albinos. The same is true of the cross colored × Himalayan, while the cross Himalayan × albino produces only Himalayan and in the second generation only Himalayan and albino. The occurrence of this variation in several species, its similarities in appearance and in inheritance, and finally the production at the same locus as indicated by allelomorphism of other similarly appearing variations indicate that the particular locus in the chromatin at which these mutations have occurred is common to a number of widely different species and although such a statement cannot be proved except by a study of linkage relations between this and other common loci, it seems very probable that albinism is homologous variation throughout the rodents and in the species studied is due to homologous genes.[5]

PINK-EYE

This name has been applied by geneticists to a unit character in rodents which is not a form of albinism, as the pinkness of the eye might indicate, but a distinct eye and fur character. Animals ex-

[5] Since this paper was written, a fourth allelomorph in the albino series in rabbits has been reported by Castle (Science, vol. 53, April 22, 1921, p. 387). This variation, now studied genetically for the first time, is known as "chinchilla" and differs from the wild gray or "agouti" coat color in the absence of yellow, and its replacement by white, and in the reduction of black to a slate blue.

hibiting this variation show a general quantitative reduction in the black and brown pigments in both fur and eyes. A certain amount of pigment is present in the iris but not enough to obscure the blood color of the retina. Yellow pigment is not affected. Pink-eyed animals with the "agouti" coat pattern therefore appear yellow since the black bases of the dorsal hairs are a reduced slaty or bluish tint and are covered by the fully intense yellow parts of the hair. Black animals with this variation are slaty or bluish all over in mice and a dirty near-white in rats and guinea-pigs. Its distinctness from albinism becomes evident when pink-eyed colored animals are crossed with albinos. The first generation offspring in this case are all as fully colored as the wild type and if inbred produce full colored, pink-eyed colored, and albino young.

The variation occurs in the following species:

Sciuridæ—*Marmota monax.
Muridæ— Mus musculus.
Rattus norvegicus.
*Microtus pennsylvanicus.
*Fiber zibethicus.
Caviidæ— Cavia cobaya.

Its occurrence in the species marked * is probable but is based only on museum specimens with the coat colors peculiar to pink-eyed animals. The eyes in the mounted specimens may or may not agree with the original.

Data on the localization of this variation are available in large numbers for mice, and in lesser amount for rats and guinea-pigs. In these species it is a simple Mendelian recessive to full color (dark-eye). In rats and mice it is certainly a homologous variation, in appearance, in inheritance and in localization, for a large amount of linkage data indicates that the genes for pink-eye and for albinism are located in the same chromosome and at about the same relative distance apart. This localizes both of these genes in both species, and leads to some interesting conclusions and speculations which will be more fully considered later. In guinea-pigs there is incomplete evidence concerning the location of the gene for pink-eye but some data which Dr. Sewall Wright has kindly extracted from his breeding records and sent to me indicate that the locus of pink-eye is not in the albino chromosome but elsewhere. As we shall see, this may prove just as instructive concerning the homologies between species in germinal constitution as the more definite localization of the gene in rats and mice.

YELLOW

The self or solid yellow coat coloration in rodents appears to be divisible as to its cause into two different categories. In the first of these may be placed those yellow varieties which have arisen by a change in a gene governing the *extension* of black and brown to the fur, and the alternative (allelomorphic) condition of *restriction* of these melanic pigments to the eye, while the pelt is yellow. In the presence of this gene (restriction [r]) the melanic pigments are probably not produced in sufficient amount or to a sufficient intensity to invade the fur, leaving the residual yellow which is present in all "agouti" animals in possession of the whole extent of the hair. This gene is recessive to full extension and is distinct in its inheritance from the gene which determines the barring of each hair in the agouti pattern. Animals may possess the gene for yellow, with the gene for "agouti" or without it. "Agouti" yellows have much lighter bellies than non-agouti yellows. Restricted yellow occurs in the following rodents:

Leporidæ—	Oryctolagus cuniculus.
Muridæ—	*Microtus pennsylvanicus.
	Peromyscus maniculatus gambeli.
	Rattus rattus.
	*Rattus alexandrinus × R. rattus.
Caviidæ—	Cavia cobaya.

The distinction between this yellow and the second type, about to be described, is made on grounds of the mode of inheritance only, for the appearance of the latter type is identical with that of the former. The pelt of the second type is yellow and the eyes are dark. The gene which differentiates it is however dominant over its allelomorphs agouti and non-agouti. This dominant yellow is known only in the house mouse and because of its peculiar mode of inheritance has been the subject of considerable research through a combination of genetic and embryological methods to which Castle, Little, Kirkham and others have contributed. Such investigations have established the following facts:

(1) Yellow house mice do not breed true but when bred together always produce yellow and non-yellow young in the ratio of 2:1.

(2) Litters from yellow by yellow are on the average 25 per cent smaller than litters from non-yellow varieties.

(3) In the uteri of yellow females pregnant by yellow males there have been found disintegrating embryos approaching 25 per cent of the total embryos.

Ordinary heterozygotes (hybrids in one character) when bred together produce 25 per cent pure dominants, 50 per cent heterozygotes, and 25 per cent pure recessives. In the offspring of yellow mice the two latter classes have appeared in the expected proportions; pure dominant yellows have never been disclosed by breeding tests. It has therefore been concluded that the 25 per cent missing from the litters, the 25 per cent of disintegrating embryos, and the 25 per cent of expected pure yellows are the same. The intrauterine death of this class has been supposed to be due to a recessive lethal gene which when received from both parents causes the death of the resulting zygote or individual. In every case this lethal gene has been transmitted with the gene for yellow. It may be either completely linked or identical with the gene for yellow. At any rate it is present at the same locus with the gene which determines yellow, and any individual which receives yellow from both parents receives likewise the lethal gene from both parents and is doomed to death before birth. As to why this combination of two lethal genes is fatal we are still in the dark.

This yellow gene and the lethal associated with it are known only in house mice,[6] and the restricted yellow of the other species has not been reported in house mice. They are probably not homologous variations in spite of their similarity in appearance. The "yellow" varieties of rats are not really to be classified with other yellow rodents since they are actually "agoutis", differentiated from the wild gray by the pink-eye gene (to which we have referred) or by the very similar red-eye gene which act selectively on the melanic pigments to reduce rather than restrict them.

WHITE-SPOTTING

Almost as common as albinism among rodents is the spotting of certain portions of the coat with white. The white areas are as devoid of pigment as in albinos but here the likeness ends. Genetically white-spotting and albinism are distinct and contrary to the popular belief are not quantitatively but qualitatively unlike. Albinism is fundamentally the loss or change of a factor for the development of a peroxidase essential to the production of any pigment (cf. Wright '17) and its effects are of a general nature throughout the pelt and eyes. Spotting appears to be a change in a factor governing the distribution

[6] Several other factors may modify the appearance of yellow in mice; for instance, certain darkening factors in the presence of the yellow gene produce the black-and-tan and sable varieties of mice, while intensifying factors in the presence of yellow produce the brighter orange or red varieties.

of the pigments in the pelage. When pigmentation is present all over the pelt the condition is known as self or not-spotted. Spotting is inherited independently of albinism, since certain albinos crossed with spotted animals throw only selfs, while other albinos derived from white-spotted colored stocks have given spotted offspring. An albino may therefore be genetically either self or spotted although unable to give evidence of this condition except in its offspring by a colored animal which supplies the gene for the development of color.

On the grounds of its inheritance white-spotting in rodents may be classified in three categories. The first of these is piebald or Dutch spotting, apparently due to a gene recessive to self coloration and probably independent of other coat color unit characters. It may thence be present with albinism, yellow, pink-eye, agouti or black (see below). Piebald animals may be characterized by a typical localization of the spotting in a belt or collar as in belted mice or Dutch rabbits; the spotting may be confined to the face ("white-face" mice), or it may be distributed in a fairly uniform dorsal pattern as in hooded rats.[7] On all of these types the white-spotting varies only within general limits. In other piebald mice and in guinea pigs especially it appears purely at random, in irregular blotches hardly approximating any pattern at all. The spotting may also vary in amount from a few white hairs to over half the surface of the animal, although in general the pigmented areas exceed the white portions in total size. The belly is likewise more susceptible to spotting than the dorsum. This variation has been noted many times in wild species and I am certain the present list which has been hastily compiled does not represent the true distribution of this variation among rodents in general.

Leporidæ—	Oryctolagus cuniculus.
Sciuridæ—	*Sciurus finlaysoni.
Muridæ—	Mus musculus.
	Rattus norvegicus.
	*Evotomys gapperi.
Caviidæ—	Cavia cobaya.

In the rabbit, rat, mouse, and guinea-pig the similarity of its inheritance points toward a homology in this variation. Data on its localization are lacking except that in mice it is probably not located in the same chromosome with albinism and pink-eye, nor with the black-eyed white-spotting about to be discussed. In rats and guinea-pigs

[7] A hooded *Microtus* has been noticed in the Museum of Comparative Zoology at Harvard University.

it is likewise not linked as far as is known with any other color variation, while in rabbits it may be a property of the same locus at which English or dominant spotting is determined.

The two other categories of spotting are peculiar each to a single species. The English broken spotting of domesticated rabbits is a Mendelian dominant to self-color and has no probable homologue in other species, while the black-eyed white-spotting of mice, likewise a dominant, is apparently peculiar to mice although wild rodents resembling this type have been reported (e.g., *Sciurus finlaysoni*). This last variety is interesting in that it is less pigmented than any other type of spotting studied, some black-eyed white-spotted mice having pigment only in the eyes, while the rest of the pelt is pure white. It is discontinuous with piebald spotting, and is, like yellow, an unfixable hybrid, always throwing, when bred pure, a ratio of two black-eyed whites to one piebald. The cause of this peculiarity has lately been traced to its association with another lethal factor which determines the death in utero of all pure black-eyed white zygotes.

BLACK

One other color variation is common enough in rodents to make comparison profitable. This is the discontinuous change from the "agouti" coat to one which is black all over and it is probably due in all the species in which it occurs to a gene determining the exclusive development of black and brown pigments. It is always present in wild "agouti" type rodents and its appearance alone is conditioned by the change producing non-agouti, or the absence of the "agouti" pattern. Its recessive allelomorph is brown, which has occurred in rabbits, mice, guinea-pigs and possibly in rats. This gene is probably not linked with any of the other known genes in mice, but its relationships in other species have not been studied. The variation from agouti to black occurs in the following species:

Leporidæ— Oryctolagus cuniculus.
*Lepus americanus virginianus—Eastern varying hare.
Sciuridæ— *Sciurus hudsonicus?
*Sciurus niger ludovicianus.
*Sciurus niger niger.
*Sciurus carolinensis leucotis.
*Tamias striatus lysteri.
Muridæ— Mus musculus.
Rattus norvegicus.
*Fiber zibethicus.
Caviidæ— Cavia cobaya.

Specimens of individuals of other species which are much darker than the wild type are often seen in museums, usually labelled "melano" or "melanic variation." Many of these should not, I believe, be assumed to represent the true black variation. Some, as in "melanic" squirrels of various species, prove on close examination to be only very much darkened "agoutis" in which the black portions of each hair have been extended at the expense of the yellow portions. This variation has been studied by Punnett in the rabbit and found to be due to a gene distinct from black which is allelomorphic with the extension-restriction pair of allelomorphs. Much darkened "agoutis" have been produced in mice by crossing intense blacks or black-and-tans (a darkened form of yellow) with wild agouti-colored mice. The darkness is due in this case to a series of modifying genes distinct from either black, "agouti" or yellow which in the presence of these genes bring about an increase in the amount and intensity of the black pigment granules and a reduction in yellow. Such extended or darkened "agoutis" can usually (though not always) be distinguished from black by the lighter belly which is typical of the "agouti" pattern.

In addition to the coat color and pattern variations discussed above, many others have occurred in rodents which have been bred in the laboratory, though they are as yet known in too few species to make comparisons profitable. One of these, dilution, is a unit character in mice and rabbits. In this variation, the pigment granules are clumped and reduced in distribution, producing when acting on black varieties the familiar maltese color of blue rabbits and mice. The maltese cat is the result of a similar variation from black. Dilution is a simple Mendelian recessive to full color. The red and black blotching of guinea-pigs, the ticking or banding of the belly hairs in guinea-pigs, and the white bellies of a fancy variety of "agouti" mice are also known to be Mendelian unit characters.[8]

SUMMARY

A summary of the preceding discussion shows that we have examined five of the commonest variations in rodents: albinism, pink-eye, yellow, white-spotting, and black. In all of these the inheritance is known for at least three species, and in general the variant is recessive to the wild type. Dominant variations have occurred often enough (such as

[8] For a fuller discussion of these the interested reader is referred to Chapter XII in Castle's "Genetics and Eugenics," 1920, and to the series of papers by Wright cited above.

"English spotting" in rabbits, and black-eyed white-spotting and yellow in mice) to make us chary about drawing any general conclusions concerning the occurrence of evolution purely by loss mutations from type. The generality that does appear is rather the widespread occurrence in this order of similar variations both under domestication when the animals are saved and bred, and in the wild, when usually only the stuffed specimens are preserved. There is implied in this similarity, which in certain cases amounts to a homology, a similarity in that part of the organism which is responsible for the variations, i.e. the germ plasm. It may be that we know in these days as little concerning the *causes* of variation as did naturalists in the days of Lamarck or of Darwin. We do at least know where the causes are to be sought, and, once having arisen by a mysterious occurrence called mutation, we have learned something of the manner in which the variations are inherited, and by a process of inference have been able to localize still more exactly the region of change. The only permissible generality, then, concerns a general similarity in the germ plasm and probably in the individual chromosomes of these many species of rodents. But in one case the similarity between species has been found to be more than general. It has been found to be quite a specific similarity.

If we examine this case in detail we find that in two distinct, intersterile species, mice and rats, two similarly appearing variations have occurred, albinism and pink-eye. In rats the genes for these variations are linked with a strength of about 21 per cent, which is possibly slightly in excess of the actual. In mice the linkage between these genes in something less than 15 per cent, which is based on observations of 6700 animals raised solely for the purpose of determining this linkage and is probably reasonably accurate. In terms of the chromosome hypothesis these facts mean that these two genes are present in the same chromosome in rats and mice, in rats at a distance of 21 units apart, in mice at a distance of about 15 units apart. The difference in location is so small that for practical purposes we can say that they are located at homologous points in the two species.

In guinea-pigs where both of these variations occur, there is incomplete evidence, but the data which Doctor Wright has supplied indicate that pink-eye and albinism in guinea-pigs are probably not linked and may therefore be determined in different chromosomes. This does not prove, however, that these variations in guinea-pigs are *not* the same as those in mice and rats. It may mean that the chromosome which contains both genes in the more primitive Muridæ may in the

more specialized Caviidæ be represented by two chromosomes, the sum of which rather than either one separately may be homologous with the one chromosome of mice and rats. Although this will be recognized as speculation, there is some slight evidence that in the evolution of the rodents a fractionation of chromosomes may have occurred, for the mice and rats have 19 (haploid) while the guinea-pigs have 28. In the rabbit (*Oryctolagus cuniculus*) a member now judged too primitive for the true rodents and recently placed in the Lagomorpha with the others of the old rodent suborder Duplicidentata, the chromosome number is probably 12. If this progressive increase in the number of chromosomes through the order Rodentia is found to be a fact and not a chance phenomenon associated with the smallness of the sample of four species from which our cytological evidence is drawn, it may furnish a very important clue to a series of evolutionary relationships of more than ordinary interest.

In the concluding chapter of his recent book Professor Morgan (1919) has referred to the possible evolutionary significance of the localization of genes as determined by the study of linkage. He has there reviewed some of the work on similar variations in several species of insects by Metz and Sturtevant, pointing out the difficulties to be encountered in applying this method to the analysis of species, chief of which is the necessity of establishing the same linear order in each species of the genes for similar variations. A species in his point of view, and in this he follows De Vries, may ultimately prove to be a "community of genes." We may expect evidence of this community in the variations which arise from time to time within the species, whether they be at the time of specific value or not. Such community is not to be inferred from mere similarity in appearance but must rest on a more real homology of germinal cause. This kind of similarity is now apparent between *Mus musculus* and *Rattus norvegicus*, which have varied so far from a common type that they are now inter-sterile and have been placed recently in different genera. Yet they have retained a genetic constitution so similar that it contains genes common to both species. Whether this is due to a community of descent in the terms of current evolutionary theory or to relationship through some other cause is one of the questions which genetics, aided by the chromosome notation, may be expected at some time to answer.

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A HYBRID DEER OF THE F_2 GENERATION

BY HARTLEY H. T. JACKSON

[*Plate 8*]

INTRODUCTION

Among deer hunters who search for their spoils on the eastern slopes of the Cascade Mountains in the state of Washington, it is quite generally known that in a certain region the mule deer (*Odocoileus hemionus hemionus*) and the Columbian black-tailed deer (*Odocoileus columbianus columbianus*) hybridize. This area is where the western range of of the mule deer and the eastern range of the black-tail overlap. It may be roughly outlined by the summit of the Cascade Mountains on the west; the region of Stampede (or Yakima) Pass and lakes Keeches and Keechelus on the north; a line drawn north and south through a point 6 miles east of Signal Peak, the Tieton Basin, and Frost Mountain on the east; and Mount Adams on the south. Mr. James Henderson writes:

> This cross breeding of the mule deer and the Columbia black-tailed deer is not common. . . . . The different varieties of deer have their respective ranges very well defined, the mule deer seldom going to the summit of the divide and never, to my knowledge, beyond on the west slope. They are very much more scarce than the black-tails near the summit. I believe the lack of mates of their own kind leads the bucks of this variety to cross with the does of the black-tailed kind. Their offspring will then mate with either. (Letter to the U. S. Biological Survey from James Henderson, Mabton, Washington, April 24, 1917.)

Very few of these hybrids have found their way into mammal collections and, their direct lineage being unknown, any of them collected in their native habitat would have little, if any, scientific value, in so far as studies in heredity are concerned. In March, 1917, the United States Biological Survey received a hybrid deer from Mr. A. S. Hormer, North Yakima, Washington, which had been raised in captivity by Mr. James Henderson. This specimen, a tanned skin accompanied by imperfect skull, is now numbered 223,685, United States National Museum, Biological Survey Collection. In regard to this animal Mr. Henderson writes:

This deer was killed in January, 1915, and would have been 4 years old the following May. It was rather a tall rangy deer of good proportions and fairly large bones. It was born and raised in my enclosure and was killed on account of becoming so vicious as to be very dangerous. I procured his grandsire from Ellensburg, Washington, on the east slope of the Cascade Mountains. He was a fine specimen of mule deer, full blood. The granddame was secured near South Bend on Willapa Harbor on the coast of this state. She was a full blood Columbia black-tail. These two deer mated and produced a pair of female fawns. About the same time I procured a full blood mule doe from the same man who furnished me the mule buck, Mr. Chris Gray, of Ellensburg, Washington, now deceased. This doe was with fawn to a full blood Columbia black-tail buck owned by Mr. Gray. This mule doe gave birth to a pair of male fawns after she came into my possession and at about the same time as the other pair was born. I selected a female from one pair and a male from the other pair of fawns and raised them until they bred and raised the deer of which you now have the skin and head.

. . . . There are quite a few [hybrids] on the east slope of the Cascade Mountains, where a few full blood mule deer live, going down on the east side in winter, while the Columbia black-tail go down the west slope to winter. Owing to the small numbers of mule deer they sometimes cross breed in their wild state and readily cross in domestication when dependent on man for existence. (Letter to U. S. Biological Survey from James Henderson, Mabton, Washington, March 29, 1917.)

COMPARISON OF THE HYBRID WITH ITS PARENT SPECIES

The ancestry of this animal (H^2) is represented graphically in figure 1. Unfortunately none of the parents or grandparents of the specimen is available and all that can be attempted in the present paper is to compare it briefly with each of its parent species. The mule deer differs in external characteristics from the black-tail in that it is a larger animal; the ears are relatively longer, and larger in general; the hair on all surfaces of the tail for the proximal $\frac{2}{3}$ to $\frac{3}{4}$ of its length is white or whitish, whereas in the black-tail the upper surface of the tail is covered

with black or blackish hairs the entire length; the metatarsal gland is longer in the mule deer; the antlers are larger in all proportions, with the primary divisions of the beam forking at a lesser angle, the anterior fork extending more nearly vertically to the plane of the occiput (less forward and inward). Cranially the mule deer differs from the black-tail in that the post-frontal region arises distinctly

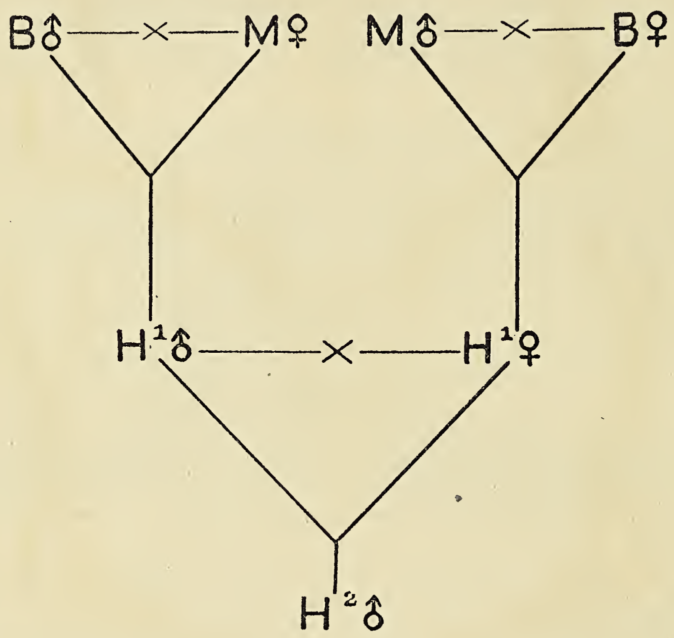

FIG. 1. DIAGRAMMATIC REPRESENTATION of ANCESTRY OF SPECIMEN NUMBER 223,685, U. S. NATIONAL MUSEUM, BIOLOGICAL SURVEY COLLECTION

B, Columbian black-tailed deer; *M*, mule deer; H^1, hybrid from first cross; H^2 (specimen 223,685), hybrid from second cross; ♂, male; ♀, female; ×, crossed with.

higher and more abruptly, producing in effect a more depressed interorbital region, whereas in the black-tail the superior aspect of the skull is comparatively flattened. There are other *average* differences between the two species, but in fully adult animals of comparable age the two forms seem to be sharply differentiated in each of the above characters, there being no overlapping, nor intermediates, in the numerous specimens examined.

SKULLS OF DEER

FIG. 1. *Odocoileus columbianus columbianus*. Number 8154, U. S. Nat. Mus. Puget Sound, Washington.

FIG. 2. *Odocoileus columbianus columbianus* × *Odocoileus hemionus hemionus*. Number 223,685, U. S. Nat. Mus., Biological Survey Coll. Mabton, Washington.

FIG. 3. *Odocoileus hemionus hemionus*. Number 230,960, U. S. Nat. Mus., Biological Survey Coll. Winthrop, Washington.

The hybrid specimen is not strictly intermediate in characters between *hemionus* and *columbianus*. In some characters it is indistinguishable from *hemionus*, in another like typical *columbianus*, and in one respect it appears to be intermediate. On the whole it is more like *hemionus* than like *columbianus*. The hybrid was a large deer and, in size, would pass for a rather large *hemionus*. It also has the large ears characteristic of the mule deer. The metatarsal gland on the left leg measures, in the tanned skin, 125 mm., that on the right leg 119 mm., in every respect typical glands of full blood *hemionus*. The antlers also are indistinguishable from those of the mule deer. They are not as long as some mule deer antlers, but have as heavy beams as any I have examined, and branch in a fairly normal mule-deer fashion. The tail, however, is distinctly and unmistakably like that of a black-tailed deer. The post-frontal region of the skull appears to be intermediate between that of a black-tailed deer and that of a mule deer, but probably is nearer that of the black-tail. Viewed in life then, this animal undoubtedly had the appearance of a mule deer with a black-tailed deer's tail.

CONCLUSIONS

It is to be admitted that from a geneticist's point of view this paper is not entirely satisfactory and that a more serious study of the specimen might bring out many additional facts. However, three points are worthy of notice. Regardless of variance of opinions as to the definitions of a species and a subspecies, so far as I am aware it has been conceded by all mammalogists that the mule deer and the black-tailed deer are distinct species. The first point, then, is that within a certain area in the state of Washington *two distinct species*, the mule deer and the black-tailed deer, *interbreed in their native habitat.* Second, the *hybrids of the first filial generation* produced by the crossing *of these two distinct species are fertile to each other.* Third, it is strongly *suggested that in these crosses certain unit characters are transmitted to the offspring.* The hybrid studied was essentially a mule deer in several characters, black-tailed deer in at least one character, and showed a possible tendency to be intermediate in one. Whether these characters are transmitted in Mendelian ratio is, of course, impossible to determine with the material at hand.

U. S. Biological Survey, Washington, D. C.

FOSSIL CETACEANS FROM THE FLORIDA PHOSPHATE BEDS

By Glover M. Allen

[*Plates 9–12*]

The occurrence of fossil cetaceans in Florida was briefly made known by Leidy, who, in 1889, recorded "half a dozen vertebræ and several teeth of several Cetacea of the family of the Dolphins" from the Peace Creek deposits. Concerning these remains, however, he makes no comment beyond the fact that they were "undetermined." More recently, in the commercial development of the phosphate beds, particularly in Polk County, additional fragments have come to light. Three of these are figured with brief mention, by Sellards (1915, p. 102–105) in the Seventh Annual Report of the Florida Geological Survey, but no attempt has been made to identify the species which they represent. Through the kind offices of Mr. Anton Schneider, lately Superintendent of the Amalgamated Phosphate Company, and through the interest of Vice-President F. F. Ward of the International Agricultural Corporation with works at Mulberry, the Museum of Comparative Zoölogy has recently acquired a few additional remains of fossil Cetacea from Polk County, and these, together with several fragments generously loaned by the Florida Geological Survey, form the basis of this paper.

GEOLOGICAL OCCURRENCE

All the specimens come from what are known as the "land-pebble phosphate deposits," which, according to current geological opinion (Sellards, 1915, p. 58) constitute a pebble conglomerate, accumulated under marine or estuarine conditions, probably during late Miocene or early Pliocene time. This conglomerate forms the basal member of the "Bone-Valley formation," and is derived chiefly from an older phosphatic marl of Upper Oligocene age, from which have probably been redeposited the teeth of sharks and rays, casts of invertebrates, and silicified corals that occur with the broken but unworn bones of later-deposited cetaceans and crocodilians. It is believed that this area was exposed as a land surface during most, if not all of the Miocene, at the close of which it was again submerged, thereby allowing the accumulation of the conglomerate together with the remains of aquatic vertebrates of the period, in what must have been a relatively shallow sea.

The cetacean remains consist of fragments of the skull or vertebræ, and though for the most part badly broken, seem to have suffered as much from rough handling during extraction as from actual erosion, since they are chiefly such pieces as chanced to have been rescued in the course of mining the phosphate. Exact data as to the original relations of the specimens in the deposit are therefore unobtainable.

SPECIES REPRESENTED

At least three species of cetaceans, pertaining to as many genera, are represented by the material in hand. Two of these are dolphins of the slender-beaked type common in Miocene deposits of Europe, and related to the existing Iniidæ of estuarine and fluviatile habitat. Of these, one seems referable to the genus *Schizodelphis*, first recognized as occurring in America by True (1908); the other is a related genus for which a new name is proposed. It is peculiar in that the lower tooth rows close, proximally at least, *within* the upper, instead of interlocking. What seems to be a species of the same genus is present as well in Miocene formations of Europe, though the Florida species is more progessive than the European, and appears to represent the culmination of its line of evolution. The third species falls in the Physeteridæ or sperm-whale family. It is a whale of medium size, apparently congeneric with a species—*Diaphorocetus poucheti*—described from the Miocene of Patagonia. Like that species, it differs from existing members of this family through the possession of a rostrum rather narrow basally and provided with fully functional teeth in the upper as well as in the lower jaw.

An account of these fragments follows.

INIIDÆ—River dolphins

Schizodelphis depressus sp. nov.

Plate 9, fig. 1–5

1869. ? *Priscodelphinus grandaevus* Leidy, Journ. Acad. Nat. Sci., Phila., ser. 2, vol. 7, p. 434 (in part).

1904. ? *Rhabdosteus latiradix* Case, Md. Geol. Surv., Miocene, p. 24 (in part), pl. 15, fig. 1 (not of Cope).

1908. ? *Priscodelphinus sp.?* True, Proc. Acad. Nat. Sci., Phila., p. 28, fig.1–3.

Type.—A fragment of the beak, 828 Fla. Geol. Surv., about 283 mm. in length, broken off in advance of the vomer; found five miles south of Bartow, Florida.

General characters.—A long-beaked dolphin of the *Schizodelphis* type, but

differing conspicuously from *S. sulcatus* in the flattening of the rostrum anteriorly and from *S. crassangulum* in the wider spacing and apparently greater size of the teeth. A shallow, broadly V-shaped groove occupies the midline of the palate and gradually fades out toward the tip of the beak. From the edge of this groove the plane of the maxilla slopes gently upward and outward to the strongly rounded lateral border, but near the tip of the beak the palate becomes nearly flat. The alveoli are large, the more proximal the smaller and separated by an interval less than the length of a single alveolus. The more anterior sockets are larger and farther apart, being separated by an interval nearly 1½ the length of a single alveolus. The alveoli themselves are nearly oval in outline, the more proximal directed slightly outward and forward, but the more distal with their long axes nearly parallel to the tooth rows.

Description.—This species is represented in the collection of the Florida Geological Survey by two fragments of the rostrum. The larger, here made the type of the species, is a section broken from slightly in advance of the palatal portion of the vomer. Its length is 283 mm., its breadth at base 48 mm., tapering to 37 mm. wide at the broken distal end. Its left basal end just includes the beginning of the deep longitudinal groove separating maxillary and intermaxillary. The combined intermaxillaries are at this point high (13 mm. above the groove) and broad (32 mm.) but become depressed and flattened forward, though losing little of their width. Though the right intermaxillary is very slightly the narrower, there is no marked asymmetry.

The large alveoli are nearly oval in outline and shallow. The first six or seven at the proximal end of the fragment are smaller and closer together than those succeeding and have their long axes turned slightly outward. The proximal four of the right side are smaller and closer together than those corresponding on the left side, and are included within a space of 31 mm. The separate alveoli average 6 by 3.5 mm., and are about 2 mm. apart. Beyond this point they are larger and of nearly uniform size, about 7.5 by 4.5. mm., elliptical in outline with their long axes parallel to the tooth row. The interspaces gradually increase to about 10 mm. at the anterior end of the fragment.

The second specimen (5885 Fla. Geol. Surv.) referred to this species, came from much nearer the tip of the beak. It is 172 mm. long, 28 mm. wide at the proximal and 25 mm. wide at the distal end. Its dorsal portion is largely formed by the intermaxillæ, which are nearly flat above, and have fused medially so that no trace of the original suture is evident. The combined width of the intermaxillæ is 18 mm. proximally and 13.5 mm. distally. This portion of the beak is strongly flattened dorsoventrally so that the palatal surface is nearly parallel to that of the intermaxillaries. Laterally, however, the maxillaries are slightly bevelled outward from the palate, and the tooth sockets are situated along this narrow bevelled area so that they are visible in side view. The comparatively large size, nearly elliptical outline, and wide spacing of these shallow sockets are maintained very uniformly to the anterior end of the specimen, which must have included all but a very small portion of the tip of the beak. The groove marking the line between maxillaries and intermaxillaries becomes much shallower on the right-hand side than on the left, though in the larger fragment this disparity was not noticeable.

Possibly referable to this species is the centrum of a lumbar vertebra (15786 M.C.Z.) from Mulberry. It has lost the lateral processes and the neural spine, but shows, still intact, a median dorsal ridge running nearly the entire length of the vertebra. This is low and laterally compressed, with rounded summit, and about 4 mm. high at the middle point, where on each side are one or two small pits in the groove at its base. Dal Piaz (1905) mentions a similar ridge on the vertebræ of *Schizodelphis sulcatus* and it is visible in anterior view in several of the vertebræ he figures. The centrum itself is long as compared with that of most modern dolphins, some 57 mm., lacking the posterior epiphysis. The anterior face is subcircular in outline, with a vertical diameter of 32 mm., and has a small linear depression at its center. The posterior outline is subtriangular due to the flattening of the ventral contour.

Remarks.—Of these three specimens, the larger rostral fragment recalls very strongly a similar piece from the Miocene of Shiloh, New Jersey, referred by Leidy (1869) to his *Priscodelphinus grandaevus* and figured as such by Case (1904, pl. 15, fig. 1), and again as *Prisco-delphinus sp.*? by True (1908 a, p. 28, fig. 1–3). Indeed, the Florida specimen seems to offer little in itself to distinguish it from the New Jersey fragment, except that its intermaxillæ in side view are possibly higher in proportion to the maxillaries. All the fragments may therefore be provisionally considered as representing the same species. The selection of a name for them, however, is not an easy matter. For, though Leidy referred the Shiloh specimen to his *Priscodelphinus grandaevus*, the latter was really based on two caudal vertebræ of an immature animal, so that the association of the rostral fragment with these is purely assumptive, though all the bones were from the same locality. Furthermore, it is uncertain whether the caudal vertebræ on which the species *grandaevus* was founded, are congeneric with the dorsal vertebra which Leidy made the type of the genus *Priscodel-phinus*. Moreover, there appears to be some ground for believing (True, 1908) that this genus is itself identical with *Schizodelphis*. If this identity could be shown through the discovery of an associated skeleton, the former name would have priority, and the latter would then become a synonym of it. But awaiting further light on the matter it seems best to retain the two generic names as originally applied. True (1908 a) in referring again to Leidy's specimen refrains from giving it a specific name, but the occurrence of what seems to be the same dolphin in the Florida deposits makes it advisable to give it a distinctive title for convenient use, even though the fragments at hand are insufficient for a complete diagnosis.

Pomatodelphis gen. nov.

Diagnosis.—Long-beaked dolphins resembling *Schizodelphis* in general form of the skull except that the rostrum has a convex expansion of the maxillary outline at the proximal end of the tooth rows; combined width of lower jaws narrower than the upper so that the lower tooth rows close *inside* the upper (like the lid of a pot—πῶμα); teeth of lower jaw directed upward into the maxillary, where the tips of the more posterior are received in shallow pits, instead of being, as in *Schizodelphis*, directed outward and interlocking with the maxillary teeth outside the tooth rows.

Genotype.—*Pomatodelphis inaequalis* sp. nov.

Pomatodelphis inaequalis sp. nov.

Plates 10, 11

Type.—A fragment, 15750 M.C.Z., from the base of the right maxilla, 114 mm. long, comprising one-half the breadth of the palate, from Brewster, Polk County, Florida. Gift of Amalgamated Phosphate Co., through Anton Schneider and Thomas Barbour.

Description.—The type fragment includes thirteen small and much compressed alveoli, of which the posteriormost are close together but the more anterior are much farther apart. All are round-edged and contract forward to a point; they are mere slits and probably did not support functional teeth. Internal and parallel to this row of thirteen alveoli is a series of some ten or eleven shallow pits made by the tips of the mandibular teeth, which closed perpendicularly against the maxilla inside the line of the upper tooth row. The palate itself is quite flat. The external border of the maxilla is abruptly and strongly rounded.

Three specimens in the collection of the Florida Geological Survey supplement the type most acceptably. They comprise a cranium, which though in several fragments wants little more than the terminal part of the beak and the middle portion of the brain case; a second imperfect rostrum, comprising most of the base of the beak; and a third fragment from near the tip of another rostrum. From these a fairly clear idea of the cranium may be gained.

The summit of the cranium instead of culminating in the elevated nasals, as in modern Delphinidæ, is formed by a transverse crest along the line of union of the frontals and the supraoccipital. The latter seems to have been nearly perpendicular to the long axis of the cranium, so that the back of the skull is rather squarely truncate. The interparietal appears medially at the apex of the skull, as a narrow transverse bone wedged in between the large supraoccipital and the frontals. It is about 40 mm. from side to side and 6 mm. in antero-posterior extent in the midline, tapering to a point at each side. In front of it appears a slightly depressed rectangular field formed by the frontals, some 25 mm. square against the anterior side of which abut the remains of the nasals.

The blowholes are embraced by the proximal ascending portions of the intermaxillæ, the tips of which are here contracted to a blunt point in contact with the middle of the frontal on either side, some 10 mm. in advance of the transverse occipito-frontal ridge. A large foramen opens under the posterior margin of

each intermaxillary. It is continued forward and inward beneath this bone and is probably the opening of a perforation of the maxillary quite obvious in most modern dolphins, but here covered by the expanded intermaxillary. The backward extension of the maxillary almost completely covers the outer part of the frontal, at least on the right-hand side, and thus heightens the appearance of fore-and-aft compression of the brain case.

The intermaxillaries are broad, thin and nearly plane posteriorly, but quickly become narrower opposite the front of the blowholes, and then slightly expand, their surfaces sloping inward toward the triangular area in front of the nares, before continuing forward on to the beak. A very shallow groove runs from near the outermost part of this proximal expansion, forward and inward, becoming lost at the inner sloping margin of the triangular area. A similar groove is present in *Schizodelphis*. At this level commences a marked asymmetry. The right intermaxillary suddenly narrows while the left broadens out for a short distance and becomes much thinner at its outer edge. Forward from this point both intermaxillaries become raised and thickened, extending as two parallel flat-topped ridges, closely appressed medially, to the broken extremity of the beak. From the flattened maxillaries they are sharply marked off by a deep longitudinal groove along the line of contact. The right intermaxillary is markedly the smaller and its delimiting groove the shallower.

A fragment (2343 Fla. Geol. Surv.) from very near the tip of a rostrum, and apparently representing the same species, shows that the two intermaxillaries fuse medially toward their distal extremity.

The base of the rostrum is peculiar in outline. Opposite the anterior tips of the pterygoids it becomes strongly compressed from side to side, with gently concave margins as seen from below; then it expands widely, reaching the greatest convexity opposite the base of the visible part of the vomer, beyond which it tapers forward to form the beak. The tooth rows begin just in advance of the widest expansion. There is thus a distinct neck formed at the base of the rostrum succeeded by a convex expansion, very different from the gradual and even taper from the maxillary notches forward, seen in *Schizodelphis*. A somewhat similar outline is seen, however, in the newly discovered living genus, *Lipotes* (Miller, 1918). In ventral aspect, the entire palate in advance of the vomer is quite flat with a shallow median V-shaped groove where the bevelled edges of the maxillaries meet. It thus differs markedly from *Schizodelphis sulcatus*, in which according to the figures of Dal Piaz (1903, p. 195) the maxillaries are strongly bevelled outward. At the base of the rostrum the pronounced asymmetry previously noted in the dorsal aspect is again evident. For while on the left-hand side of the beak the proximal part of the maxilla widely expands, carrying with it the tooth row, on the right-hand side the expansion is less marked, and the palatal surface is much more nearly in a vertical plane so that the tooth row is placed much higher on the cheek. The alveoli are also smaller and closer together on the right-hand side in this region.

The vomer appears in advance of the palatals as a narrow lozenge-shaped slip about 100 mm. long by 8 wide in the broadest place. Fortunately enough remains of the posterior end of the vomer to fix the shape and position of the blowholes. That of the right-hand side is much the smaller and opens well to the right of the median axis of the skull, while that of the left side is so much larger

and has so encroached on its neighbor that it has come to occupy a median position. This asymmetry seems not to be found in *Schizodelphis* (the apparent asymmetry shown in Dal Piaz's figures, 1903, pl. 1, is obviously due to distortion of the fossil). Although an accurate measurement is not possible, the left blowhole seems to have been at least 20 mm. in antero-posterior diameter, the right-hand blowhole about 14 mm.

The alveoli of the upper jaw, particularly those of the right-hand side, are more or less slit-like, rounded posteriorly and contracted to a point forward. Their edges instead of being sharply defined, are rounded, with a healed-over appearance, and it seems probable that if teeth were present at all in the upper jaw they must have been very small, non-functional, and with bases buried in the gums instead of fitting into sockets. The posterior alveoli of the left side are apparently a little larger at the base of the rostrum and may have held small teeth.

Most remarkable is the series of depressions seen on the palate *internal* to each tooth row, in at least the basal portion of the beak. These are obviously made by the tips of the *mandibular* teeth, and may or may not come opposite the alveoli of the upper jaw. Their presence indicates that the teeth of the mandible closed vertically *into the maxilla*, that they were larger than the maxillary teeth if any existed, and that the width across the lower tooth rows was less than that across the upper alveolar series. This allowed the upper jaw to close over the lower jaw like the lid of a pot. A certain parallelism may be seen here with the sperm whale, in which the lower jaws are in like manner narrower than the width between the upper alveolar lines, the rostrum has at the same time become expanded, and the upper teeth have become functionless. No doubt this modification is a result of a change from an actively fish-capturing habit to one requiring less seizing and holding as in the squid-eating (teuthophagous) cetaceans generally.

In the fragment, from the right side near the base of the rostrum, there are 6 alveoli in a space of 33 mm., with intervals of from 2 to 8 or 9 mm. between them, and 6 depressions formed by the mandibular teeth in a space of 55 mm. In the larger rostral fragment (5834 Fla. Geol. Surv.) there are:

Right side	6 alveoli in 32 mm. near base
	6 alveoli in 56 mm. near end
	6 depressions in 50 mm. about halfway
Left side	6 alveoli in 53 mm. near base
	6 alveoli in 68 mm. about halfway
	6 depressions in 69 mm. about halfway

In the small fragment from the tip of the beak (2343 Fla. Geol. Surv.) there appear to be 6 aleovli in about 35 mm.

The posterior end of the cranium (5834 Fla. Geol. Surv.) which has served for the greater part of the above description, is considerably broken, but enough fragments remain to afford a good idea of its appearance. The condyles are large and prominent yet quite without the distinct neck shown in skulls of *Schizodelphis sulcatus* (Abel, 1899; Dal Piaz, 1903). That of the right side is the larger. The lack of a distinct neck to the cranial condyles and their large smooth surface tending to merge with that of the occiput show a progressive condition considerably ahead of the latter genus. The greater fore-and-aft compression is further shown by the notably shorter distance both relatively and absolutely between

the glenoid cavity of the jaw and the cranial condyles. The occipital crests arise as sharp ridges from the upper side of the squamosal processes, and meet in a transverse ridge at the summit of the skull. Posteriorly the squamosal and adjacent surfaces are irregularly pitted or roughened for muscle attachments, quite unlike the smooth surfaces in skulls of modern dolphins. The glenoid cavity for the articulation of the jaw is relatively small, a primitive feature, and that of the right side is the smaller. A broad groove bounds the lower inner margin of the articulating surface.

The specimen affords the following complete measurements:

	mm.
Extreme width of skull across squamosal processes	199.0
Width of braincase across bases of same	143.0
Width across occipital condyles	91.5
Right condyle, greatest vertical diameter	52.0
Right condyle, greatest transverse diameter	32.0
Left condyle, greatest vertical diameter	49.0
Left condyle, greatest transverse diameter	30.5
Foramen magnum, greatest vertical diameter	27.0
Foramen magnum, greatest transverse diameter	40.0
Lip of foramen magnum to basisphenoid suture	81.0

Remarks.—In establishing this new genus and species a careful review of the literature has been made in order to ascertain if other specimens, congeneric with it, have been described. It is obvious that species and genera based on other parts of the skeleton than the cranium can at present afford no sure points of comparison. There are, however, two specimens from the Miocene of Europe, that appear to be referable to the new genus. The first of these is a fragment of the right maxilla first mentioned and figured by Cuvier (Rech. sur les Oss. Foss., 1823, ed. 2, vol. 5, pt. 1, p. 317, pl. 23, fig. 38) as belonging to a "dauphin dont une portion de mâchoire supérieure a été trouvée dans le calcaire grossier du département de l'Orne." In the fourth edition of the same work (1836) the specimen is said to be from the "département de Maine-et-Loire." Whichever locality may be correct, it is fairly certain that the horizon is Miocene, probably middle Miocene. The specimen is next referred to by Holl (1829) in a work rarely cited, Handbuch der Petrefactenkunde. Here it is listed as "*Delphinus stenorhynchus* Cuv." with brief mention and reference to Cuvier's work. The latter author, however, though having observed in his original account, that the species was unlike any other hitherto described, gave it no name either in this or in the later editions of the Ossemens Fossiles, and apparently quite overlooked or ignored Holl's name. Thus Holl, though citing Cuvier as authority, seems to have been himself the actual author. Later writers, including Brandt,

have attributed the name to Keferstein (1834), who, however, cites it without reference as a synonym of *D. longirostris*, a name applied to a living species of *Prodelphinus* by Gray in 1828, and to a species of *Delphinus* by Dussumier in 1829. In 1846, Laurillard, evidently supposing that the fossil required a new specific designation formally bestowed the name *Delphinus renovi* upon it after the original discoverer, and it is so figured in three views by Van Beneden and Gervais in the Ostéographie. Finally, Longhi in 1898, referred it to the genus *Champsodelphis*. As may be gathered from the figure (Text-fig. 1), it agrees with the Florida species in the strongly convex outline of the base of the maxilla. In both, the proximal end of the tooth row makes

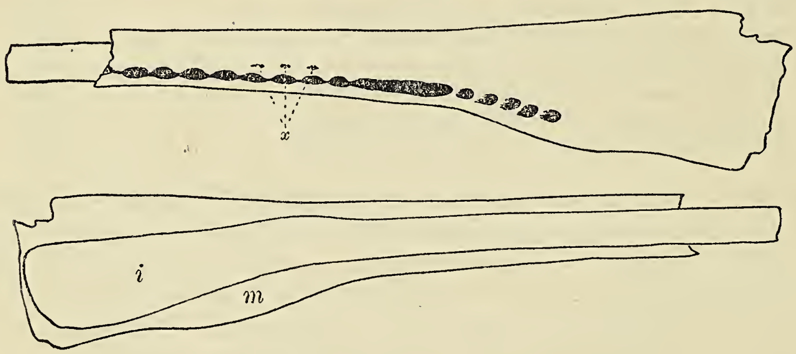

Fig. 1. *Pomatodelphis stenorhynchus* (Holl)

Dorsal (lower fig.) and ventral (upper fig.) outlines of the type specimen. France, Département de l'Orne. After Van Beneden and Gervais, Ostéographie, pl. 57, fig. 9. *i*, intermaxillary; *m*, maxillary; *x*, depressions for reception of mandibular teeth.

an outward bend at this point, but in the French specimen the row of alveoli ends about opposite the summit of the convexity, whereas in the Florida species it ends in advance of this point. Moreover, the alveoli themselves seem much larger in the former and doubtless supported functional teeth. A more important point is indicated in the figure by the presence of three shallow depressions near the middle of the length, internal to the alveolar row, for the reception of the points of the corresponding mandibular teeth. This detail, perhaps not fully brought out by the artist, shows that the lower tooth row closed *within* the upper, at least proximally, and, taken in connection with the similarity of the maxillary outline, seems to indicate at least a generic affinity with *Pomatodelphis*.

It seems almost certain that Paquier's *Schizodelphis depereti* is the same species as that represented by Cuvier's fragment. The type specimen comprises the cranium forward of the blowholes and most of the lower jaw, but the rostrum has been broken off somewhere near its middle. The excellent photographs of the specimen show the same convexity at the base of the maxillary, while the broken and projecting end of the lower jaw is obviously much narrower than the upper at the same point, as if it had closed *inside* the latter, a point further indicated by the fact that the small lower tooth preserved is expressly stated to have its tip hidden in the upper maxillary. In both dorsal and ventral views, the right and the left sides show no marked asymmetry. Abel (1899) though admitting many discrepancies between this skull and that of *Schizodelphis sulcatus,* nevertheless dismisses it as representing probably the latter species. The locality of Paquier's specimen is southern France, "les carrières de Chamaret (Drôme)" in the Rhone valley. The formation is the "mollasse burdigalienne," considered to be lower Miocene. Assuming that Paquier's specimen represents the same species as Cuvier's from northern France, the synonymy will stand as follows:

Pomatodelphis stenorhynchus (Holl)

1823. Dauphin . . . . du département de l'Orne, G. Cuvier, Rech. sur les Ossemens fossiles, ed. 2, vol. 5, pt. 1, p. 317, pl. 23, fig. 38 (see ed. 5, 1836, p. 168, pl. 224).

1829. *Delphinus stenorhynchus* Holl, Handbuch d. Petrefactenkunde, part 1, p. 70.

1834. *Delphinus longirostris* oder *stenorhynchus* Keferstein, Die Naturgeschichte des Erdkörpers, vol. 2, p. 203 (not *D. longirostris* Gray, 1828; not Dussumier, 1829).

1841. *Delphinus longirostris* H. von Meyer, Neues Jahrb. f. Mineral., 1841, p.327.

1844. *Delphinus renovi* Laurillard, in D'Orbigny, Dict. Univ. d'Hist. Nat., vol. 4, p. 634, pl. fig. 38.

1873. *Delphinus renui* Brandt, Mém. Acad. Imp. Sci. St. Pétersbourg, ser. 7, vol. 20, p. 247 (*emendatio*).

1894. *Schizodelphis depereti* Paquier, Mém. Soc. Géol. de France, vol. 4, no. 12, p. 7.

1898. *Champsodelphis renovi* Longhi, Atti Soc. Veneto-Trent. Sci. Nat., Padova, ser. 2, vol. 3, p. 333.

Though referred to the same genus, there seem ample grounds for considering the French species distinct from the Florida one. The figures of the former, especially that of Cuvier representing the right maxillary, show the proximal alveoli large and somewhat closely

crowded, instead of small and well spaced. The intermaxillaries in profile do not curve upward so abruptly, their outline as seen from above is different, and there is no such marked asymmetry as shown in *P. inaequalis.* The latter in its greater specialization seems to be a more progressive species, as might perhaps be anticipated from its supposedly later geologic appearance (upper Miocene or lower Pliocene).

The peculiar vertical implantation of the mandibular teeth, and the fact that at least the more proximal close within the maxillary rows, suggest a possible relationship to *Platanista,* in which exactly these conditions occur at the base of the beak, although in other respects the latter genus shows far greater specialization, as in the greater compression from side to side, of the entire rostrum. The development of its characteristic maxillary crests seems of less systematic importance, for incipient crests are found in *Phocœna* on the intermaxillaries, and very large ones in *Hyperoodon* on the maxillary bones.

PHYSETERIDÆ—Sperm whales

Diaphorocetus mediatlanticus (Cope)

Plate 9, fig. 6; Plate 12

1895. *Paracetus mediatlanticus* Cope, Proc. Amer. Phil. Soc., vol. 34, p. 135.
1902. *Hypocetus mediatlanticus* Hay, Bull. U. S. Geol. Surv., no 179, p. 596; Case, Md. Geol. Surv., Miocene, 1904, p. 30, pl. 17, figs. 6a, 6b.
1904. *Hypocetus atlanticus* Case, Md. Geol. Surv., Miocene, expl. of plates, p. 9 (*errorim*).
1898. *Diaphorocetus mediatlanticus* Trouessart, Cat. Mamm., new. ed., p. 1053; 3d ed., 1905, p. 772.

To this genus and species are referred a fragment of the lower jaw, including both rami, from the phosphate beds at Brewster, Polk County, and a second fragment comprising the occipital condyles, from Mulberry. Apparently pertaining to the same species is the beautiful specimen figured by Sellards (1915, p. 103, fig. 32), also found at Mulberry, consisting of the basal portion of the rostrum including both upper and lower jaws. Most unfortunately, this piece, which was for a time in the possession of the International Agricultural Corporation, has been disposed of and cannot be traced.

The genus *Hypocetus* was established by Lydekker in 1893, as a substitute for *Mesocetus* (preoccupied) of Moreno (1892), type *Mesocetus poucheti,* a medium-sized cetacean of the sperm-whale family,

with well developed, functional teeth in the upper as well as in the lower jaw. On a subsequent page of the same paper, Lydekker, evidently through inadvertence, calls the genus *Paracetus*, but *Hypocetus* has page priority. This paper, though bearing date 1893, was actually issued in April, 1894, and is, therefore, later than a paper by Ameghino dated February, 1894, in which the generic term *Diaphorocetus* is proposed for the same specimen and thus has priority (see Palmer, Index Gen. Mamm., 1904, p. 341). A further difficulty in the specific reference lies in the fact that it is not clear whether Cope's species *mediatlanticus* really differs from Moreno's *poucheti*. The type of the latter is a fairly well preserved skull lacking the jaw, from Bahia Nueva, Chubut Territory, Patagonia, found in a formation which Ameghino believed to be of Eocene age, but which is now considered to be lower Miocene (True, 1910, p. 31). Cope's type of *mediatlanticus* is a large fragment consisting of the base of the rostrum with the alveoli of the proximal seven or eight pairs of maxillary teeth, and parts of the intermaxillaries, vomer, and adjacent bones. It is from the St. Mary's formation at Drum Point, Maryland, now regarded (Cushman, 1920, table opp. p. 40) as of upper Miocene age. Cope attempts no comparison of his specimen with Moreno's *poucheti*, beyond the statement that the two are "not distantly related." From Case's figure of the type, however, it appears that the alveolar row extended back only to the level of the middle of the vomer, whereas, in Moreno's figure (1892, pl. 10) of *poucheti*, indications of alveoli seem to continue considerably posterior to the vomer. A slight difference in the outlines of the palatal bones is also seen, but how far these differences are individual rather than specific must await the discovery of additional specimens. It therefore seems best to retain Cope's name *mediatlanticus* for the present and to refer the Florida fragments provisionally to it. A description of these follows.

(1) The finest specimen of all is the fragment of rostrum figured by Sellards (1915, p. 103, fig. 32), as the "side view of upper and lower jaw of another cetacean." It is shown at about one-half natural size and was 300 mm. long, comprising a portion of both jaws broken from slightly in advance of the symphysis. It obviously includes some of the posteriormost of the teeth. Its upper profile is nearly plane with a line parallel to it marking the suture between maxillary and intermaxillary. The ventral outline of the lower jaw shows the distinct angle at the beginning of the symphysis so characteristic of the sperm whales. Posteriorly from this angle the teeth of both jaws at once show a successive diminution in size, while in advance of it they are all of a nearly uniform size and

spacing. The opposing series of the two jaws interlock, with the points of the teeth directed outward, those of the more posterior slightly recurved. A longitudinal crack appears in the mandible, evidently due to crushing. The photograph shows very clearly that the teeth had distinct crowns, doubtless of enamel, which stand out dark and discolored in contrast to the white of the exposed roots. Eleven maxillary teeth are apparent in the figure and at least ten mandibular teeth (Plate 12, fig. 13).

(2) The second fragment is from Brewster, Polk County (15751 M.C.Z.), the gift of Dr. Thomas Barbour. It is a section, some 150 mm. long, of the conjoined mandibles beginning slightly in advance of the symphysis. At the posterior end the rami are separate for about 20 mm.; in front of this point they begin to contract slightly in width and are thoroughly fused together with the line of contact deeply impressed. Three complete alveoli with parts of two others are present in each ramus. The posteriormost on the right side is the smallest. It contains a root still in place and is separated by a narrow interval from the alveolus next in advance. The three succeeding alveoli are about of the same size with interspaces greater than those separating the alveoli of the left side. From this it results that the corresponding sockets of opposite sides are not in the same transverse plane, but alternate with the opposite interspaces. The lengths of these sockets and interspaces are:

	Left ramus	*Right ramus*
Proximal socket	—	18
First interspace	10	2
Second socket	22.5	20
Second interspace	9.5	12
Third socket	20	22
Third interspace	8	15
Fourth socket	20	20
Fourth interspace	15±	16±
Combined length of middle three sockets	78	90

A slight asymmetry is thus evident in the rami of opposite sides.

The two roots still in place are broken off at the level of the jaw and are nearly oval in section, with the longest transverse diameter turned outward and forward in the posteriormost but nearly parallel with the tooth row in the anteriormost tooth. In side view are seen several short and shallow depressions in the rami marking the exit of the mental nerves. About halfway up on the ramus a very shallow longitudinal groove is evident, beginning from the most proximal of these exits just in front of the symphysis.

(3) The third fragment referred to this species is a portion of the base of a skull from Mulberry, comprising the occipital condyles (15787 M.C.Z.). These are prominent and rounded, though but slightly marked off from the occipital surface by a raised border. Their greatest vertical diameter is very nearly at right angles to the transverse plane of the skull, and the greatest width is at about the middle point of their height. In measurements they are practically identical with those recorded by Moreno for *D. poucheti.*

MEASUREMENTS OF 15787 M.C.Z.

	mm.
Greatest transverse width across both condyles	144
Greatest vertical diameter of right condyle	93+
Greatest vertical diameter of left condyle	100±
Greatest width of right condyle	57
Greatest width of left condyle	59
Distance between right and left condyles above	41
Distance between right and left condyles below	14
Foramen magnum, vertical diameter	63±
Foramen magnum, transverse diameter	45

It is possible that a cetacean vertebra from Brewster figured by Sellards (1915, p. 105, fig. 33) belonged to a whale of this same species.

SUMMARY

It is evident that the three fossil cetaceans here noticed have much in common with species occurring elsewhere in Miocene formations. The first, *Schizodelphis depressus*, is closely allied to a species represented in the Miocene of Shiloh, New Jersey, if indeed it is not identical with it. The second, *Pomatodelphis inaequalis*, is referred to a new genus that apparently occurs as well in the lower and the middle Miocene of France, where, however, it is represented by a less specialized species. The implantation of the teeth suggests a possible relationship to *Platanista*, though it is considered one of the Iniidæ. The third is closely related to a cetacean described from the lower Miocene of Patagonia and is believed to be identical with a species, *Diaphorocetus mediatlanticus*, discovered in the upper Miocene of Maryland. On the whole, therefore, the evidence of the cetacean remains points to a late Miocene age for these "pebble phosphate" deposits of Florida. The two species of Iniidæ seem to represent the terminal members of a group now extinct, though related to the existing river dolphins. The one Physeteroid is a more primitive representative of a group that has survived to the present day, but whose living members, perhaps through a change from fish-eating to squid-eating habits, have lost the functional teeth of the upper jaw.

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EXPLANATION OF PLATES

Plate 9

Fig. 1. *Schizodelphis depressus*, sp. nov. Palatal view of basal portion of beak, from near Barstow, Florida. Type, 828 Fla. Geol. Surv. × .39.

Fig. 2. Dorsal view of same.

Fig. 3. *S. depressus*, a fragment from near tip of beak. 5885 Fla. Geol. Surv. ×.39.

Fig. 4. Dorsal view of same, showing fusion of intermaxillaries.

Fig. 5. Centrum of a lumbar vertebra referred to *S. depressus*, showing median ridge projecting into neural canal. Mulberry, Fla. 15786 M.C.Z. × .39.

Fig. 6. *Diaphorocetus mediatlanticus* (Cope). Cranial condyles, posterior view. Mulberry, Fla. 15787 M.C.Z. × .43.

PLATE 10

FIG. 7. *Pomatodelphis inaequalis*, sp. et gen. nov. Portion of rostrum, palatal view, showing the asymmetry of structure, and the row of depressions for tips of mandibular teeth internal to the maxillary tooth row. Those of left side partly filled by plaster. *n, n*, the blowholes; *v*, vomer. 5834 Fla. Geol. Surv. × .5.

FIG. 8. Dorsal view, showing the entire specimen. × .44.

FIG. 9. *P. inaequalis*, a fragment from near tip of beak, dorsal view, showing fusion of intermaxillaries, and dorso-ventral flattening. 2343 Fla. Geol. Surv. × .75.

PLATE 11

FIG. 10. *Pomatodelphis inaequalis*, palatal view of fragment of right maxilla. The nine depressions for reception of mandibular teeth are indicated by dotted line to center of each. Brewster, Fla. Type. 15750 M. C. Z. × .90.

FIG. 11. Same, dorsal view of summit of skull, showing (outlines dotted): frontals (*f*), bases of intermaxillaries (*i*) and maxillaries (*m*), interparietal (*ip*), and part of supraoccipital (*so*). 5834 Fla. Geol. Surv. × .50.

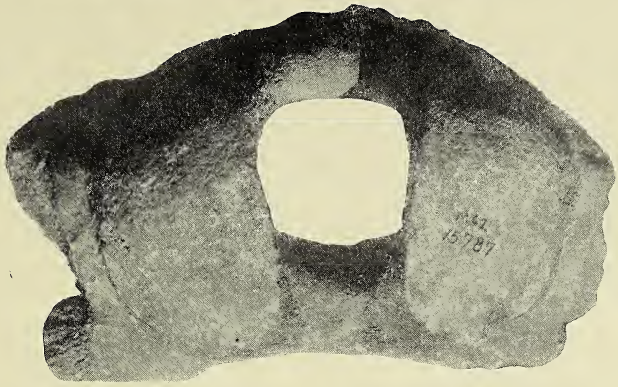
FIG. 12. Same, posterior view of supraoccipital fragment (above), condyles, and squamosal processes of cranium. 5834 Fla. Geol. Surv. × .50.

PLATE 12

FIG. 13. *Diaphorocetus mediatlanticus* (Cope), base of rostrum in side view, showing teeth in both jaws. Found near Mulberry, Fla., but now lost. (Cut loaned by Fla. Geol. Surv.; see Sellards, 1915, p. 103). × .50.

FIG. 14. Same, dorsal view of jaw fragment from just in advance of symphysis. Brewster, Polk Co., Fla. 15751 M.C.Z. × .83.

Cambridge, Massachusetts.



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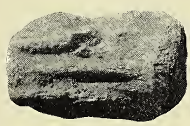

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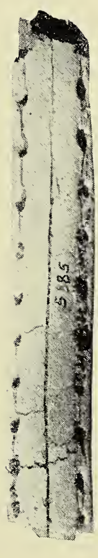

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(Allen: Fossil Cetaceans from Florida)

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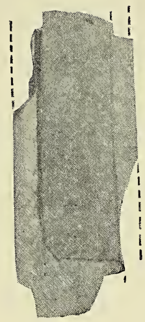

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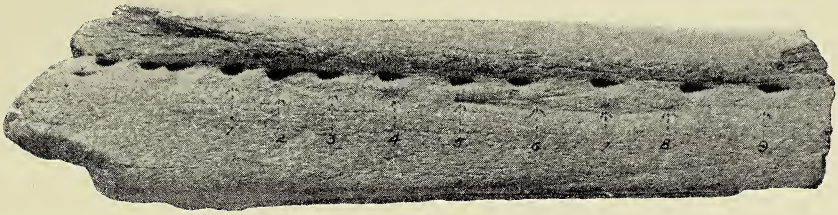

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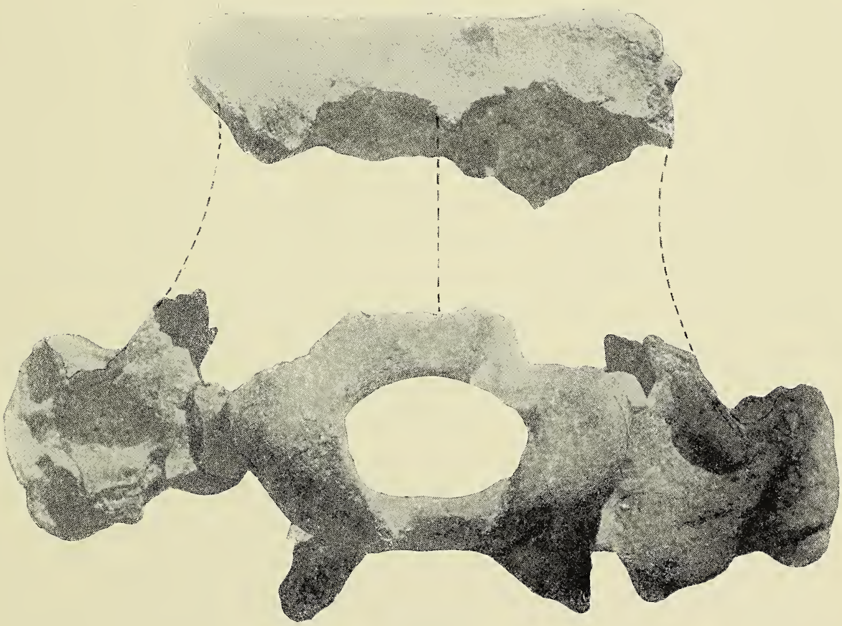

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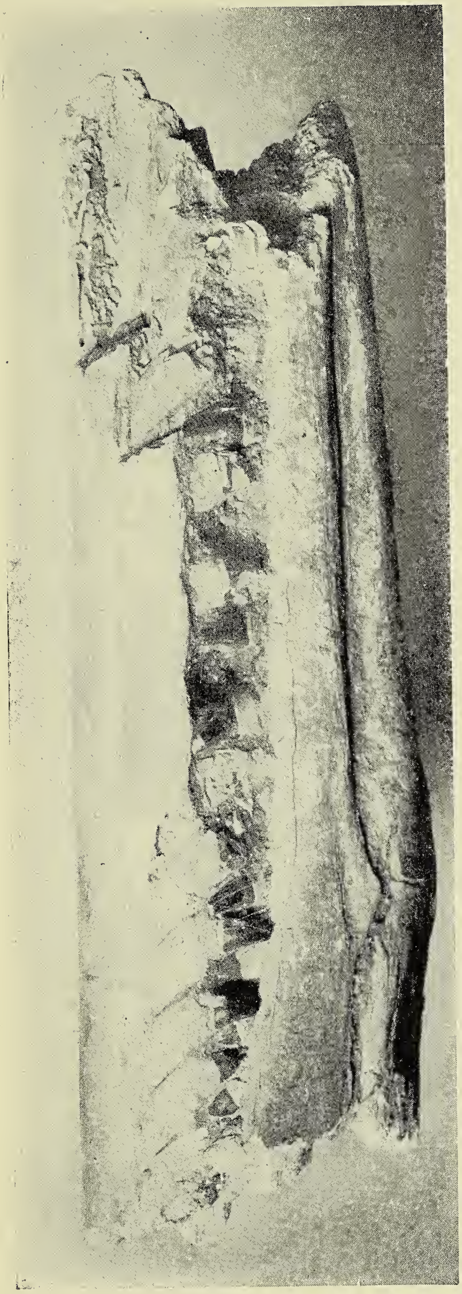

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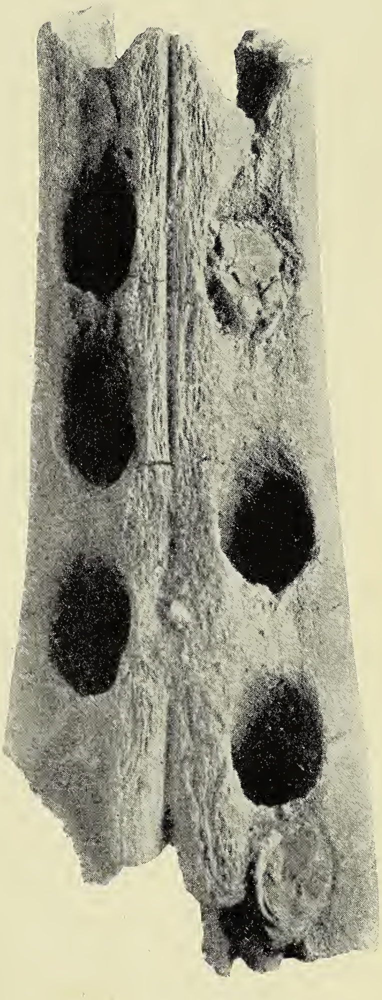

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(Allen: Fossil Cetaceans from Florida)

TWO UNRECOGNIZED SHREWS FROM CALIFORNIA

By Hartley H. T. Jackson

Continued studies upon American Soricidæ for the United States Biological Survey have disclosed two heretofore unrecognized forms from California. That their names may be available for other workers they are here described in advance of the complete report.

Sorex obscurus parvidens subsp. nov.

SAN BERNARDINO DUSKY SHREW

Type-specimen.—No. 56,561, United States National Museum, Biological Survey Collection; ♂ adult (teeth slightly worn), skin and skull; collected October 3, 1893, by J. E. McLellan. Original number 242.

Type-locality.—Spring known as Thurman's Camp, Bluff Lake, altitude 7,500 feet, western side of San Bernardino Peak, San Bernardino Mountains, California.

Geographic range.—Known only from San Bernardino Mountains, California.

Diagnostic characters.—Similar in size and color to *Sorex obscurus obscurus;* skull about the size of that of *S. o. obscurus*, narrower interorbitally, with distinctly flatter cranium, which is less expanded mastoidally (consequently the skull averages narrower in greatest lateral diameter); molariform teeth more deeply emarginate posteriorly, the unicuspids narrower, and the first incisors smaller.

Color.—*Winter pelage:* Unknown. Probably not essentially different from winter pelage of *S. o. obscurus. Summer pelage:* Similar to that of *obscurus;* upperparts between olive-brown[1] and buffy-brown, tending slightly toward Soccardo's umber, and gradually blending with color of underparts; underparts smoke gray more or less tinged with avellaneous or light ochraceous-buff; tail distinctly bicolor, olive-brown above, buffy brown below, darkening toward tip.

Skull.—Narrower interorbitally than that of *S. o. obscurus*, with narrower and distinctly flatter braincase, and, on the average, weaker dentition, the molariform teeth usually with more deeply emarginate posterior borders.

Measurements.—Type-specimen: total length, 105; tail vertebræ, 45; hind foot, 12.8 (measured from the dry skin by the writer). *Skull* of type-specimen: condylobasal length, 17.1; palatal length, 6.7; breadth of cranium, 8.1; interorbital breadth, 3.5; maxillary breadth, 5.0; maxillary tooth row, 6.2.

Remarks.—Only 6 specimens of this shrew have been examined, 4 of which are in Biological Survey Collection and the other 2 in the

[1] Colors here used are those of Ridgway, R., Color standards and color nomenclature, 1912.

collection of Mr. Donald R. Dickey, Pasadena, California. The rather flat and narrow skull of *Sorex o. parvidens*, combined with its weak dentition, distinguish it from other forms of the species *obscurus*.

Sorex pacificus sonomæ subsp. nov.[2]

SONOMA SHREW

Type-specimen.—No. 19,658, Museum of Vertebrate Zoology, University of California; ♂ adult (teeth moderately worn), skin and skeleton; collected July 2, 1913, by Alfred C. Shelton. Original number 227.

Type-locality.—Sonoma County side of Gualala River, Gualala, California.

Geographic range.—Coast region of California from Point Arena, Mendocino County, south to Point Reyes, Marin County.

Diagnostic characters.—Similar to *Sorex pacificus pacificus* but averaging smaller, and a trifle darker and less reddish in summer pelage.

Color.—*Winter pelage:* Essentially like that of *Sorex p. pacificus*. *Summer pelage*: Averaging somewhat darker and less reddish than that of *S. p. pacificus;* scarcely more reddish or cinnamon than in winter pelage. Upperparts mummy brown or fuscous, the color of the upperparts extending well down over the sides; underparts between olive-brown and buffy brown, tending toward sepia; tail essentially unicolor, about same color as underparts.

Skull.—Similar to that of *Sorex pacificus pacificus*, but averaging smaller.

Measurements.—Type-specimen: total length, 133; tail vertebræ, 59; hind foot, 16. *Skull* of type-specimen: condylobasal length, 21.1; palatal length, 8.9; breadth of cranium, 10.3; interorbital breadth, 4.5; maxillary breadth, 6.3; maxillary tooth row, 8.1.

Remarks.—The southern form of *Sorex pacificus*, here described under the subspecific name *sonomæ*, is separable from true *pacificus* only in average differences of size and color. There are occasionally small specimens of the subspecies *pacificus* which match fairly well the larger specimens of *sonomæ*. On the whole, however, the differences are clearly marked.

U. S. Biological Survey, Washington, D. C.

[2] I am indebted to Dr. Joseph Grinnell, Director of the Museum of Vertebrate Zoology, University of California, for the privilege of describing this shrew from the collection under his administration.

THE COAT COLOR OF MOLES

By Loye Miller

Castle,[1] in his studies of color inheritance in various domestic rodents, learned that the gray coat of wild rabbits is highly complex in its nature, the resultant of joint action of several independent factors, and that the various color phases known to the rabbit fancier are but the effect of weakening or loss of one or more of these factors. He recognizes in the rabbit no less than eight such factors and offers as evidence of their presence, the mathematical results obtained in cross breeding. Any one who will follow the account of his experiments with some measure of care will perforce admit the weight of his conclusions and will concede that the methods of analysis by careful pedigreed cross breeding approach in accuracy the work of an analytic chemist.

The eight factors established for the rabbit are as follows:

1. A color factor, necessary to the formation of all pigment and absent in albinos.
2. A factor for black.
3. A factor for brown.
4. A factor for yellow.
5. A factor for intensity of color.
6. A factor for pattern of individual hairs.
7. A factor for self coloration, i.e., no white spotting.
8. A factor for extension of dark pigments from extremities of ears and feet.

This formidable array of color factors, each acting as an entity in transmission through the generations, can be proven only from the record of tremendous numbers of cross matings under absolute control, hence such proof is out of the question in a wild race. However, by taking account of seeming parallelism and by making use of the occasional sporadic aberrant that comes to the hand of the field naturalist, some pardonable conjecture may be formulated.

The very interesting account by Patterson[2] of a cinnamon phase of the roof rat, developing in Travis County, Texas, represents such a case. The rat in an animal that can usually be kept in captivity and reared in large numbers, so attempts to breed the new cinnamon roof

[1] Castle, W. E., Studies of Inheritance in Rabbits, Carnegie Inst. Publ., 1909, p. 45.

[2] Patterson, J. T., Science, n.s., vol. LII, no. 1341, p, 250, 1920.

rat are doubtless ere this proving successful. Results with some of our less domestic and less amenable animals are harder to obtain, hence any light that the field naturalist can shed upon the subject should be welcomed. It is to encourage the reporting of such sporadic cases and possibly to contribute to a slowly accumulating fund of evidence, that this note is offered for publication.

An abnormally colored specimen of the southern California mole, *Scapanus latimanus occultus*, was recently placed in my hands by a student who had captured it in a gopher trap in the city of San Gabriel, California. The specimen is, to my way of thinking, far more interesting than an ordinary case of albinism. It is not an albino but is light cinnamon yellow in color. This pigment, with the glistening quality of the mole's fur, results in a beautiful golden effect quite pleasing to the eye. It seems to me that this particular blunder on the part of nature has an even greater interest beyond its beauty in that it may throw some light upon the color composition of the mole.

The normal color of the species under discussion is, at first impression, a uniform slate gray with silvery reflections. This uniformity is notable in nestlings, in half grown, and in adult specimens. It applies to the individual hair from practically its base to its tip as well as to the entire body of the animal. Only on the extreme margins of the lips or upon the nearly bare feet and tail do we find a lighting up of the dark slate monochrome by whitening of the hairs. The simplest conclusion would be that color in the mole is due to a single heritable factor even as color in the human negroid was at one time supposed to be. Those who have seen the startling results of segregation of determiners displayed in red-haired mullatos may be ready to concede the possibility of complexity in the slate monochrome of moles.

MICROSCOPIC STUDY OF THE HAIR

The fully developed hair of the southern California mole is a structure of varying diameter with very thick cortex and relatively small medulla. A succession of three or four constrictions of both cortex and medulla, resulting sometimes in complete loss of the latter, is noticeable between base and tip of hair. The hair is narrow at its base and is widest in a region near the tip whence it begins to taper off to a point. Along the medulla the pigmented areas appear as dark masses resembling bubbles of india ink regularly distributed along a capillary glass tube, except that they are more like discs than bubbles

and their thickness is commonly less than their diameter. The space between discs is but slightly greater than the thickness of the disc. In the regions of constriction the form of the color masses becomes modified by a reversal of proportions and they become elongated to styliform proportions before being finally pinched out by loss of the medulla. Throughout the major portion of the hair the colored areas appear perfectly black. However, where they are thinned out by terminal or intervening constriction of the medulla the last ten or twelve become progressively less purely black until the terminal style appears dark umber brown. This appearance is less marked in the intermediate constrictions than in the terminal one and is nowhere revealed except by careful scrutiny. The proportion of these brownish areas is so small and the difference in color is so slight that the effect is entirely lost in viewing the pelt as a whole.

The cortical part of the hair is glistening white and clears to almost complete transparence. Only at rare and irregular intervals is a slight rusty stain visible. The thickness of the cortex and its freedom from color are probably responsible for the silvery sheen of the mole's fur.

Hairs were cleared in carbol-xylol to reduce the effect of air bubbles in microscopic study.

HAIR OF THE NESTLING MOLE

In a nestling so young that the hair lies flat and is quite stiff, the color is identical with that of the fully adult animal. There is the same monochrome pattern of the pelt as a whole, and the same lack of pattern in the individual hair, except where constriction, obliterating the medulla, leaves but the silvery cortex. In the specimen at hand the hair is so short that there is but one of these constrictions, that at the base of the hair, instead of three or four as seen in the adult. There can be no question then that the hair is fresh and unabraded. There appears the same slight rusty stain in the cortex in about the same degree as in the adult. The color areas are indistinguishable from those of the adult. Where the pigment becomes thinned out at the constrictions, the same umber brown is evident. It is a question then, so far as microscopic study of the normal mole is concerned, whether the color area carries a single pigment which is so darkly brown as to appear black or bears a black and a yellow pigment intimately commingled. Study of the hair with the oil immersion lens failed to disclose a commingling of individual granules of pigment of different colors. If

there be a genetic complex of color determiners present in the mole, as has been demonstrated for various rodents, it can not be seen that they affect different granules. The commingling must be ultramicroscopic.

STUDY OF THE XANTHIC SPECIMEN

The aberrant specimen that precipitated this discussion shows no departure from the normal beyond that of the color areas of the hair. Palms, soles, claws, and the nearly naked skin of the tail and the nose are, like those of the normal animal, practically without pigment and I can distinguish no difference between the two color phases in respect to the coloration of these parts. In preparing the skin, the eye rudiments were visible and there was noticed no difference between them and the rudiments in normal moles. Unfortunately no microscopic examination of these parts was made, so we lack proof for the assumption that the eye color was normal.

Microscopic study of the hair shows no divergence from the normal except in the matter of color of the pigment. The color areas are present and they in every other respect correspond with those of normal moles, but they are light brownish yellow instead of dense black in tone. They are readily marked off from the adjacent spaces and from the colorless cortex. The same styliform effect occurs where the medulla is constricted. Altogether, there is no reason for considering the specimen as an albino in which the whole machinery of pigmentation is lacking.

Whatever the theory of pigmentation toward which one may lean, it seems to me that this specimen represents the result of a factor dropped out, a chemical radical split off, a poverty in tyrosinase, or what you will, and that it serves somewhat to prove the complexity of color in a seemingly simple monochrome species of mammal.

Southern Branch Univ. of California, Los Angeles, Calif.

GENERAL NOTES

BATS ON MIGRATION

It may interest students of bat migration to know that the British Museum has received from Mr. P. E. Cheesman two specimens of the silver-haired bat (*Lasionycteris noctivagans*) and one of the red bat (*Lasiurus borealis*), which were obtained out of a flock of about a hundred which caught up with and settled on Mr. Cheesman's ship some twenty miles off the coast of North Carolina on the 3rd of September, 1920. The special interest of the record is that these two species were migrating in a considerable flock some way out to sea and in company with one another.—Oldfield Thomas, *London, England.*

THE NEST OF THE WASHINGTON WEASEL (MUSTELA WASHINGTONI)

On July 17, 1920, while setting a biological survey line of traps in the flats of the Nooksack River, at Excelsior, Whatcom County, Washington, in a thicket almost purely of salmonberry bushes, I was casually observing the mountain beaver burrows occurring in this locality. One burrow looked especially fresh but unusually small. Stooping, I was surprised to see, deep down in the burrow, the head of some small creature like a weasel. It drew back almost at once, so a wooden and a steel rat trap, both baited with the skinned body of a small mammal, were put down.

By evening a large female weasel, apparently the mother of those captured later, was taken in the steel trap. Next morning both traps were found untouched. By evening two nearly fullgrown weasels were taken at the same time, one in each trap. Both were males. Next morning another young male was taken in the steel trap.

It appeared that here might be a nest, for there were some indistinct though clearly worn trails leading through the salmonberry bushes to the hole, with here and there a bird feather scattered about. The hole itself, 2.5 inches in diameter, was driven between the roots of the salmonberry bushes and kept open by them. The animals had gnawed the bark from those roots adjacent to the hole to make the entrance larger. That large bluebottle flies were passing in and out this burrow not only suggested the presence of a nest but that the den might be occupied by a carnivore.

After posing and photographing the adult female, we dug into the burrow to search and found that it almost immediately entered a mountain beaver den. There, in an enlargement of one of the twisting burrows, we found a nest, about as big as a dinner plate, made of moss, and resembling a grouse nest. Under this present nest between it and the entrance were the remains of what seemed to be a very old nest, which would suggest that this den had been used in former years and had possibly functioned also as a winter nest.

The main den seemed to be inhabited by the mountain beaver as well, as fresh earth was thrown out of a burrow within a few feet of the weasel nest.

The exact dimensions of this nest are as follows: Diameter from surface of the ground to bottom of the nest, 18 inches; distance from top of ground to top of nest cell, 5 inches; diameter of nest cell, 13 inches by 14 inches; diameter of actual nest, 9 inches by 9 inches; dished portion of the nest, 2 inches deep; distance dug

by weasel from *Aplodontia* burrow to surface of ground, 13 inches; distance from exit of weasel burrow to center of nest, 30 inches.—William T. Shaw, *State College of Washington, Pullman, Washington.*

THE SEA MINK, MUSTELA MACRODON (PRENTISS)

There are traditions along the coasts of Maine, New Brunswick, etc., of a gigantic mink known as the sea mink, which was commonly trapped there during the early part of the nineteenth century. It disappeared about 1860. It is just possible that this was really the *macrodon* of Prentiss, 1903. If so, it is likely that specimens were preserved. It was the custom in the small hotels of the above region to have mounted any local animal of unusual interest in point of size, etc. These rareties were kept in glass cases as parlor ornaments or as bar-room accessories. If some of our travellers this summer would keep a lookout for monstrous minks in glass cases, and inquire also among the old-timers for information about the sea mink, we might get interesting details, or even specimens.—Ernest Thompson Seton, *Greenwich, Conn.*

THE CURIOSITY OF THE PROWLING MINK

As I slipped from the wet trunk of a windfall down into the snow, I noticed the trail of a mink leading away through the scrub pines. On account of the high elevation of the wooded hill, the distance from any pond water or brook and the deep snows and the scarcity of birds and small prey, I was somewhat surprised at the find. I looked back of the windfall and noted no trail; I scrutinized the snow on the dead trunk of the tree where the branches were heavy with needles and snow-gobs, and not three feet from my hand marks appeared the small foot prints. In the future I shall at all such times pause and look about. No other tracks appeared, only those on the trunk and the lone trail among the pines. Trees stood close to the windfall, while pine boughs swept low, so that the animal must have been traveling overhead and have dropped to the trunk below. The only birds in the woods were a few chickadees, crows, and blue jays. I have not heard of the mink as a tree-haunter or a tree-traveler; that is, of his using the interlacing boughs for any distance. In approaching the windfall I had crossed only a pheasant's track some fifty yards back, and I had noticed the trail sharply for the tracks revealed that the bird had visited every weed head sticking above the snow, diligently hunting for seeds. Weeds were few and far between, for there was some three feet of snow under a heavy crust, and upon this lay a light fall of powdery stuff some two days old. An examination of the mink trail proved it to be practically fresh, made during the night or early morning, as light forest winds had not dusted or drifted the tracks.

I decided to follow the trail and see what the animal had done on his widely ranging prowl. It led at a leisurely pace, at a seeming walk, as though time were an illusion and prey a thing unknown. Thick clumps of young birches were occasionally visited, but only such as grew in the set direction of the trail. Again, when pine boughs bending with snow swept the ground the tracks searched the shelters beneath and passed on. Pheasant and ruffed grouse tracks crossed and re-crossed, but the mink never seemed to halt in its journey over these.

Beneath a large pine the snow had fallen away from the trunk, leaving a deep hole around it; the mink circled this on the very edge. So through the woods. Only once did the animal break into a run which led it to the top of a small knoll overlooking a clearing bordered with groups of white birch, then it fell again into that leisurely pace across the untrod snow. The distance was nearly a mile to the edge of the woods.

A large pasture appeared which sloped down into a low meadow where small trees and shrubbery grew sparingly. The mink paused at the top of the slope. Then it made a half circle or sortie to one side and left a small amber colored spot on the snow, then the tracks shot straight down the slope. Halfway down a number of pheasant tracks cut across lots; the birds had dropped a number of pellets and the mink jumped to one side to sniff at these. Beyond the lowlands stood a wall of hemlocks, and among the boundary trees grew willow, alder and birches. Towards these ran the trail, straight to a brook which lay half buried under the snow.

At this point the tactics of the mink underwent a change; back in the woods the animal had seemed to be an idle prowler who merely glanced over prospects and never veered from a practically straight trail to explore even a rotten stump a yard or so to one side; while at the brook it seemed full of stealth and craftiness. The animal now became the seeker, the hunter, the killer. It jumped from the low bank into the water where grass swung lazily in the current; its tracks appeared on the opposite shore where it made a wide circle of survey and turned to the brook again. The water was shallow in places, deep toward and under the south bank, and I knew of nothing the mink could stalk there unless it were a stray sucker, trout or muskrat. Long reaches of the stream were entirely roofed over with snow. The mink took the tunnel-way, and at one place it went in, came out and walked over and then followed the irregular shore again. Now it turned abruptly from the stream, paused under a little beech where white-footed mice had tracked the snow in every direction, trotted some fifty yards out on to the smooth floor of the meadow and turned to the brook again. What prompted this foray? The brook now ran under steep banks and was quite hidden. Once again the prowler kept me to an interesting pursuit. No spot along the brook or in the waters escaped its notice. No trails appeared, only those of the mink I was following. It ran up and down, over and around, back and fourth, from one bank to another. No evidence appeared of any kill or success in its hunting.

Downstream a bit, the brook widened; the ground became marshy and hummocky. In the center of a clearing stood an old hemlock, broken off some fifteen feet above the ground. In the upper end of this relic the openings of a number of woodpecker holes appeared. The mink left the brook and in a number of leaps came to the base of the trunk. Bits of bark on the snow showed it had climbed up to explore those holes for an unlucky downy or hairy woodpecker. Beyond the tree ran the tracks of a ruffed grouse, and these it followed along the hemlocks for some distance and then doubled on its trail back to the brook. A little farther downstream the animal deliberately walked through a steel trap, but the trap had been set long, was matted in the grass and partly covered with brook rubbish. Only a small stick, barely noticable, served as a marker. I do not know whether luck was with the mink or whether it knew that the trap was harmless. As the banks became higher the brook began to be completely roofed over. The mink

trail led to the water at this point, and a walk downstream failed to discover any trace of more tracks wherever an opening appeared.

It is known that the mink is at times a traveler. In the woods the animal did not seem to enter into the pursuit of any prey. Pheasant and ruffed grouse were abroad but were not common. I found nothing of a kill. A greater portion of its trail was made at a walk which we know is a method of slow locomotion for the animal. Its usual gait is a series of fast, easy bounds. Was this animal hunting? Was hunger stalking the woods and swamps? This happened during the winter of 1920, in February, when the snowfall throughout New Hampshire was of unusual depth.—Edward Charles Hobson, *Lowell, Massachusetts.*

THE BADGER AS A SWIMMER

In the mid-afternoon of August 4, 1920, a badger (*Taxidea taxus taxus*) was found swimming in the middle of Devils Lake, North Dakota. Mr. T. H. Hubbell and I were crossing in a motor-boat from Minnewaukon Bay to Creel Bay when we noted the animal in the water a half-mile or more from the north shore, and also about a half-mile from the south shore. It was swimming with apparent ease toward the north shore, and was making rapid progress. When secured the individual proved to be a fully grown female. The specimen is preserved in the Museum of Zoology of the University of Michigan. The day had been hot and bright—conditions apparently not favorable for the wandering of this species. No one in the region, so far as could be learned, had ever before heard of a swimming badger, and I can find no published reference to such a habit.—N. A. Wood, *Museum of Zoology, University of Michigan, Ann Arbor, Mich.*

REMAINS OF A FOSSIL PHOCID FROM PLATTSBURG, NEW YORK

In 1901 the New York State Museum received from Dr. D. S. Kellogg, Plattsburg, New York, the tibia of a seal which had been recovered in October of that year from the post-glacial clays within the city limits. The bone was found at a depth of eleven feet below the surface during the construction of a sewer trench on Bailey Avenue. The soil at this locality was said to consist of a layer of sand four or five feet thick overlying fine clay. Fossil marine shells, *Macoma greenlandica* (Beck), were abundant in the upper part of the layer of clay but none were found at the depth of the imbedded bone.

The specimen has been examined by Mr. Remington Kellogg of the Biological Survey and the following statements quoted from a recent letter will indicate its affinities. "A young individual of *Cystophora cristata* (No. 14013, U. S. N. M.) from Newfoundland . . . . shows a very close approach to the fossil tibia. The lower extremity is approximately the same, including the facet for the fibula. The curvature of shaft and angle formed by the suture for the epiphysis of head, same as in *C. cristata.*" The shaft of the tibia of the fossil specimen is a little thicker in the median region than is the condition in *C. cristata.* Although similar in essential characteristics to the recent specimen with which it was compared, it is perhaps best, on account of the fragmentary condition of the remains, to record the bone as the left tibia of a fossil phocid near *Cystophora cristata* Erxleb.—Sherman C. Bishop, *New York State Museum, Albany, N. Y.*

AN OUTSIDE NEST OF A FLYING SQUIRREL

In many localities there have been no records of outside nests built by flying squirrels, therefore it seems advisable to record such observations in order to ascertain how widespread this practice is.

During the summer of 1920 I spent several weeks at Point Pelée, Ontario, collecting material for small habitat groups. On June 24 I found the outside nest of a flying squirrel (*Sciuropterus volans*) in a small tree covered with climbing bitter-sweet. A tall walnut tree four feet away gave the elevation necessary for the squirrels to "fly" to their permanent home, which was in a natural cavity of an oak sixty feet distant. Upon climbing to the nest, I found it contained one young, naked and blind, but my discovery evidently prompted its removal before the following day. The nest was constructed entirely of red cedar bark, and lined with fine, soft shreds of the same material. It was roughly ovate in shape, with the entrance near the top, at the end towards the tree trunk. The branches and vines supported it from all angles against the wind, and its compact structure and sheltered position in the vine made it fairly waterproof. In this instance it seems that the flying squirrel is an architect comparable with other squirrels. —L. L. Synder, *Royal Ontario Museum oj Zoology, Toronto, Ont.*

BEAVER "FORMS"

Although most persons who are familiar with the habits of the beaver in its native haunts must surely have seen the "forms" or resting places of the animal, yet I have failed to find mention of them in any of the literature on the beaver with which I am acquainted.

These forms, of which I have examined several in northeastern Minnesota, are not unlike those of the varying hare, except of course in the matter of size. They seem, so far as my observations extend, to be used merely as resting or sunning places during the day time, the animals returning to them daily. I have seen no indications that they are used as feeding places; they are, as a rule conspicuously free from peeled sticks; this is also true for their immediate vicinity. Whether the animals found in these forms,—I know of them only in the summer months—are males, whose presence in or about the lodges may be more or less unwelcome to the mother beaver during the time when she is rearing her young; whether they represent unmated individuals of either sex; or whether indeed they may be referable to any particular class of individuals, I cannot say. However, a specimen which I once trapped in one of these forms was a male.

All of the forms that I have seen were more or less shallow depressions in the ground, roughly oval in outline. One such form, which was occupied by a very large beaver, was situated on a muddy bank under some overhanging alders. It was approximately twenty inches in its greatest length and two inches in depth, and was littered with small chips or shredded wood. Another was in a natural depression between two slightly projecting slabs of rock and contained a rather scant bedding of dry twigs and grass. In dry situations I have seen them without litter of any kind, merely shallow depressions in the bare earth. In most instances the forms were situated close to the edge of the bank, a couple of feet or such a matter, so that the animal could quickly reach the water.

One examined last summer was located on a low river bank, among some willows and other shrubbery, about ten feet from the water; but within two feet of it was a hole about ten inches in diameter which led into an underground channel connecting with the main stream. The beaver escaped with a sudden rush and a plunge into the water hole.

Of the several forms which I took the trouble to examine, all but one were occupied by the beaver at the time they were discovered. The majority were happened upon during the forenoon but at least two that I recall were found in the early afternoon. In one instance, where the form was located in a sunny, grassy spot at the edge of a stream, my companions and I returned, near the middle of the forenoon, next day, and by exercising caution approached by canoe to within six feet of the beaver as it lay very still in its form. While I was standing erect in the canoe endeavoring to get a better view for a camera snapshot, the animal took alarm and with startling suddenness scrambled and slid into the water. While it lay in the form its head was unfortunately hidden from view and I could not see whether the animal was taking a nap or merely enjoying a sun-bath.—Charles Eugene Johnson, *University of Kansas, Lawrence, Kan.*

HORN SHEDDING IN YELLOWSTONE PARK

Records for the shedding of horns by elk, deer, and antelope in the Yellowstone National Park for a number of years are as follows:

Season 1911–1912.	Elk, March 22–April 28.
1912–1913.	Elk, March 20–May 1.
1913–1914.	Mule deer, February 24–March 13 (spike April 13).
	Elk, March 27–April 21 (spike May 15).
1914–1915.	White-tail deer, January 29–March 1.
	Mule deer, February 23–March 27.
	Elk, March 16–April 16.
1915–1916.	(Absent from the Park.)
1916–1917.	(Absent from the Park.)
1917–1918.	Pronghorn, November 15–December 2.
	White-tail deer, February 10–March 4.
	Mule deer, February 25–March 28.
	Elk, March 12–April 30.
1918–1919.	(Absent from the Park.)
1919–1920.	Pronghorn, October 20–November 25.
	White-tail deer, January 15–February 20.
	Mule deer, January 6–March 25.
	Elk, March 19–May 4.
1920–1921.	Pronghorn, October 31–November 28.
	White-tail deer, January 20–February 10.
	Mule deer, February 3–February 25.
	Elk, February 28–April 21.

It is quite usual for the "old-timers" to say that early shedding is a sign of an early spring. But such does not seem to be the case. It would appear that the condition of the animals is the main factor; and since the healthy condition of the animals on the open range is largely dependent on the forage, it would seem

that the comparative dates of horn shedding are more or less directly connected with the growth and condition of vegetation during the summer preceding the shedding season. Take the above dates for 1917–1918, which were late. The spring of 1918 was extremely early but the shedding dates were very late, and the reason is evident from the record of conditions during the summer of 1917. The winter of 1916–1917 was a hard one and the spring was very late; the forage started late and the short season did not permit it to cure properly. The horned animals did not get the usual abundance of food; the horn growth was not as strong as usual, and did not mature so early. As the horns seem to be carried about the same length of time each year, the late maturity caused a late shedding.

On the other hand the season of 1919 was early, hot, and dry, with very little forage. The horns grew at the usual rate for there was enough food during the growing period of the first half of the year. But the animals were not as strong and fat at the beginning of the winter. Then the winter was very snowy and cold and the weakened condition of the animals led to the early shedding of 1919–1920, although the succeeding spring proved one of the latest ever recorded.

The early shedding by weak and sick animals was very noticeable during the winter of 1919–1920. An old, one-eyed mule deer in evident poor health shed the first horn on December 22 and the remaining one on the 25th of the same month, and shortly afterwards died. An elk was seen on January 18 who had just shed both horns, and this animal did not live through the winter either. Since the shedding by both these animals was so evidently due to poor health, the dates are omitted from the above tabulation.—M. P. Skinner, *Yellowstone Park, Wyoming.*

A "SILK BUFFALO" ROBE

I have in my possession a buffalo robe, an heirloom in my family, which, with a similar robe, was given to my grandfather, Martin Bates of Boston, sometime between 1840 and 1850, by Pierre Chouteau, the fur trader of St. Louis, with whom my grandfather had business dealings. As the elder Pierre Chouteau died in 1849 at the age of one hundred, it is to be presumed that his son, Pierre Chouteau, Junior, was the donor of the robes. The other robe was sold, and was inferior to the one I have. This one has been in the possession of the family ever since, though no use has been made of it. My uncle, the late Charles S. Bates, son of Martin Bates, gave the robe to his niece, and told her that it was called a silk buffalo, that it was very rare and highly valued.

The hide was tanned by the Indians, and was sewed by them on the right side with sinew threads. As this made heavy ridges which might wear away the hair my cousin had the seams ripped and sewed on the other side. The skin is 70 inches long, 65 inches wide just behind the forelegs, and 71 inches wide in front of hindlegs. The dorsal area is light brown in color, with a slight drab tone in some lights. The sides are dark, almost black on the front legs. Most of this long time the robe has been kept in the dark, so that it seems probable that it has faded little or none. The hair on the back is fine, short, and curly, apparently from one to 1½ inches long, and in texture it is very soft; I suppose it might be called "silky." I have no other bison skin at hand for comparison, so cannot say if it is really any softer than the average robe. I have made a few inquiries

about such robes, but without gaining any information. Dr. W. T. Hornaday told me he had heard of them, but had never seen one.

My cousin, Miss Bates, was in the Canadian Rockies in 1906, and the guide who took her on some of her trips showed her a photograph of his family, and called attention to a skin on which the group were seated, saying that it was a silk buffalo, killed on the Canadian prairies. The guide's father was an early settler in that region, and got the skin when he first came out. The guide spoke of its rarity and value, and was much surprised and interested to learn that my cousin knew about them and owned one. Both he and my uncle said that in a large herd occasionally one of these fine silk animals was found, but never more than one.

Mr. David N. Heizer of Colorado Springs informs me that in Kansas, after the civil war, the young buffalo bulls in November were said to be in the silk.

Can any of my readers give me any information about these skins? I am naturally somewhat curious to learn if there is really any truth as to the rarity and value of these fine-haired skins.—Edward R. Warren, *Colorado Springs, Colo.*

THE CALIFORNIA GRAY WHALE ON THE COAST OF SOUTHERN CALIFORNIA

Recent writers on our Cetacea have stated that the California gray whale (*Rhachianectes glaucus*) is extinct on our coast and is, at this time, found only in small numbers along the coast of Japan. Some have gone so far as to state that it is twenty years since the last of the California grays appeared on the American coast. As I had considered this species one of our most common whales, when I left this part of the coast twenty-three years ago, I found it hard to reconcile these records with my own observations.

A trip to the Coronado Islands, twenty miles south of the harbor of San Diego, March 5, 1921, gave me the first, and, to date, the only chance of observing whales; and I was gratified to see two fine male California gray whales under conditions that rendered identification beyond question. These were the only whales of any species seen on the trip. They were northward bound and evidently migrating.

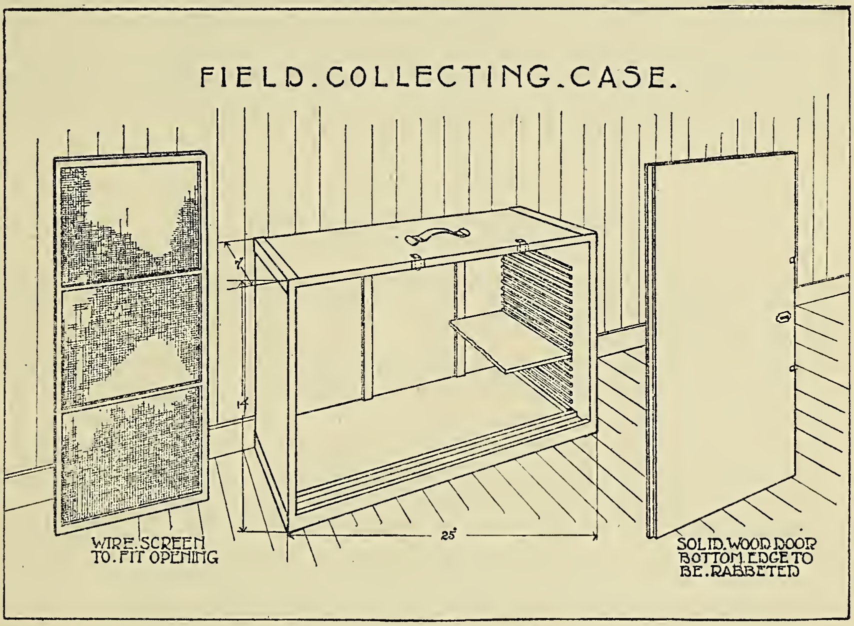
When I first came to the coast of southern California, in 1887, there were still to be found many of the old time whalers who had, from the earliest history of the whale fishery, followed the "shore whaling," hunting the "fish" from shore stations with hand-irons. These men knew the several species of our Pacific whales as they will never again be known. The present generation know little of our whales, and care less; and it is hard to obtain, at this time, any reliable data.—A. W. Anthony, *San Diego, Calif.*

A HANDY COLLECTING CASE

The case for drying and carrying specimens of birds and small mammals, shown in the accompanying drawing, is the handiest and most useful case for certain field work that I have ever seen. Upon my showing it to Dr. Walter P. Taylor, of the U. S. Biological Survey, during a recent visit of his to the California Academy of Sciences, and my explaining to him its main features, he asked me to send a description of it to the *Journal of Mammalogy* so that others might benefit by it.

As shown in the drawing, the case is 25 inches long by 14 inches high, and 7 inches deep, outside measurements. While these dimensions may be varied at will, they are those of a fairly large "suit case," and this size is handy to carry, to stow away in passenger coaches or automobiles, and will sling well on a pack saddle.

This case is made of some light, tough wood, ½ inch in thickness, reinforced at the ends with angle irons or brass. The solid outer "door" of the case is of the same material as the main body of the box, but its ends are strengthened by a strip running across grain, nailed, screwed, or glued on, as is usually done in such construction.



The shelves are of ¼ or $\frac{3}{16}$ inch wood that must be soft enough to take pins well. Five shelves to a case are ordinarily sufficient for average collecting. As shown in the cut, the cleats for the shelves do not extend quite up to the top, and when not in use for specimens the shelves can all be stowed away in the upper part, leaving the rest of the box clear for packing material and supplies, such as mouse traps, cotton, or anything not too heavy.

The cleats are short enough, and the shelves narrow enough to allow the screen door to lie between them and the outer door, so that when the latter is removed, the screen is in place to protect specimens from flies, mice, cats, etc. The frame for this wire screen should be made of tough, straight-grained wood, as it is of light construction and must stand handling in taking out and putting in place, as well as an occasional fall.

Freshly prepared skins of birds or rodents, when properly pinned to the shelves, withstand the jolting of carrying by hand and of ordinary travel in good shape, but will not resist the attacks of the average "baggage smasher," of course.

The cut shows a couple of thin perpendicular strips in the rear of the case. These are so placed as to allow the passage of air behind the shelves for the better ventilation and more rapid drying of specimens. The wire side of the screen door must always be turned to the rear so that the frame will present something for the fingers to grasp in handling.

A lock is put on the solid door, and two pieces of metal are secured in slots so as to drop down and act as catches. When the outer door is removed for drying specimens these will also keep the screen door in place. These catches, as shown in the cut, could be improved upon, or small flat bolts might be set in the door instead, so long as everything is flush with the surface. Some sort of a trunk handle on the top of the case, and a leather "tab" fastened with screws on the door to aid in handling it, complete the job.—JOSEPH MAILLIARD, *California Academy of Sciences, San Francisco.*

RECENT LITERATURE

Dixon, Joseph. CONTROL OF THE COYOTE IN CALIFORNIA. Berkeley, University of California Press, Bull. no. 320, College of Agriculture, pp. 379–397, 7 figs., April, 1920.

In this bulletin the author has succeeded admirably in presenting a concise and fair statement of the economic relations of the coyote in California and the measures proposed for its control. To those who would regret the passing of the coyote, Dixon's demonstration of the fact that "a coyote is not necessarily a bad citizen" will be welcome. With prime coyote pelts selling up to $10 and even $20 each the fur value of the animal is not to be minimized. Add to this the beneficial activities of the coyote in destroying noxious rodents, particularly ground squirrels, and it must be conceded that the economic value of the animal is a real and not an imaginary quantity. Of course, adverse testimony is not lacking. The coyote is stated to be the most destructive carnivorous animal now existing in California, and reference is made to depredations on deer, sheep, pigs, and calves. Furthermore there is, at times, grave danger of the spread of rabies through coyotes to horses, cows, goats, dogs, cats, and other domestic animals as well as to man. Consequently control measures are essential.

The bounty system is unreservedly condemned, as being vastly expensive, productive of endless fraud, and failing to give general or permanent relief. Coyote proof fences give good results under favorable conditions. The four most effective methods of destroying coyotes are stated to be trapping, poisoning with strychnine, digging out dens containing young, and shooting. It is Dixon's opinion, on the basis of results obtained in Nevada and parts of California, that cooperation in coyote control between the State and Federal governments through the Biological Survey is much superior to the bounty system. This work, supervised by the government, is carried on upon a half-and-half basis. Experienced trappers are employed on a salary and are not permitted to accept bounties from any source.

As a necessary result of the destruction of the coyote man will have to face the problem of accounting for the thousands of ground squirrels which the animals destroy each year, as Dixon clearly points out. Control measures breed control measures. Control in one direction throws nature out of balance and often gives rise to troublesome consequences which must be dealt with through additional control measures.

The case has recently been well stated by two British authorities. Watt (Journ. Ecol., vol. 7, Nov. 1919, pp. 201–202) cited herbivorous animals as a chief cause of failure of natural regeneration of the oak in Britain. As a result of the reduction in numbers of carnivorous animals there has been a general increase in rabbits, mice, moles, and certain birds. "Man by upsetting the balance of nature, and assuming control of what directly affected his own interests, is now paying the penalty in other ways, and must, having killed or suppressed the controllers, either assume total control himself or assist in such by a judicious encouragement of those animals he once considered his inveterate foes." The same point is made by Lankester, quoted by Watt, ". . . . civilized man has proceeded so far in his interference with extra-human nature, has produced for himself and the living organisms associated with him such a special state of things by his rebellion against natural selection and his defiance of Nature's pre-human dispositions, that he must either go on and acquire firmer control of the conditions or perish miserably by the vengeance certain to fall on the half-hearted meddler in great affairs. We may indeed compare civilized man to a successful rebel against Nature who by every step forward renders himself liable to greater and greater penalties, and so cannot afford to pause or fail in one single step." (Kingdom of Man, 1911, pp. 31–32).

—*Walter P. Taylor.*

Pohle, Hermann. Die Unterfamilie der Lutrinae. (Eine systematisch-tiergeographische Studie an dem Material der Berliner Museen.) Archiv f. Naturg., 85 Jahrg. (1919), Abt. A, 9 Heft, pp. 1–247; 19 text figs., 10 plates. November, 1920.

The recent and fossil otters of the world are treated in this extensive monograph. An examination of the systematic part (pp. 1–174) leads one to believe that the material available to the author in many groups hardly justified so pretentious a work. But he has drawn liberally upon the literature of the group and has compiled tables of measurements, lists of localities, and descriptions of specimens from many sources. Seven new forms are described: *Lutra brunnea*, Pontianak, Borneo; *L. maculicollis kivuana*, Kissenje, Lake Kivu, German East Africa; *L. tenuis*, Lake Mohasi, German East Africa; *L. intermedia*, Sumatra; *L. lutra ceylonica*, Nuwara, Ceylon; *Amblyonyx cinerea fulvus*, Lao Key, Tonkin, Indo-China; and *Aonyx microdon*, Dorf Bomse, Kamerun, Africa.

The name *Latax lutris gracilis* Bechstein, 1800, is revived, erroneously, to replace *Latax lutris nereis* Merriam, 1904. Bechstein's name was based upon the "slender otter" of Pennant, described from "Staten-Land." Dr. Leonhard Stejneger has called the reviewer's attention to the fact that the Staten-Land of Pennant is without doubt the most southern island of the Kurile group, north of Japan; so named by its discoverer, de Vries, a Dutch navigator, in 1643. The name *gracilis* for a sea-otter is thus a synonym of *lutris*. In this connection it

might be well to call attention to the fact that the proper generic name for the sea-otters is *Enhydra* Fleming, 1822.

The latter half of the paper includes chapters on the morphology of the skull, the history and distribution of the groups, a synopsis of the classification of otters, and a rather extensive list of titles.

—*N. Hollister.*

Akeley, Carl E. Elephants. World's Work, vol. 41, pp. 73–92; 19 figs. November, 1920.

——— The autobiography of a taxidermist. World's Work, vol. 41, pp. 177–195; 24 figs. December, 1920.

——— My acquaintance with lions. World's Work, vol. 41, pp. 277–288; 9 figs. January, 1921.

——— Hand to hand with a leopard and some experiences with rhinos. World's Work, vol. 41, pp. 393–402; 8 figs. February, 1921.

——— Hunting the African buffalo. World's Work, vol. 41, pp. 497–504; 8 figs. March, 1921.

——— Bill my Kikuyu gun-bearer, and some of our adventures together in East Africa. World's Work, vol. 41, pp. 594–607; 18 figs. April, 1921.

Ames, H. T. Wolves and foxes plentiful. Wisconsin Conservationist, vol. 3, no. 1, pp. 15–16. March, 1921. (Claims increase in numbers of foxes, coyotes, and wolves in Wisconsin.)

Anthony, H. E. New mammals from Jamaica. Bull. Amer. Mus. Nat. Hist., vol. 42, pp. 469–475; 1 plate and 4 figs. December 11, 1920. (New genera and species of fossil rodents: *Clidomys osborni*, *C. parvus*, *Spirodontomys jamaicensis*, *Speoxenus cundalli*, and *Alterodon major*.)

Barber, W. E. The blood-stained trail of the white-tailed deer in Wisconsin. Wisconsin Conservationist, vol. 3, no. 1, pp. 1, 2. March, 1921. (A plea for continuation of the "one buck law" in Wisconsin.)

Cabrera, Angel. El primer okapi vivo en Europa. Bol. Real Soc. española Hist. nat., vol. 19, pp. 443–445, 1 fig. October, 1919.

——— Dos ejemplares de "Ziphius" de las costas mediterráneas de España. Bol. Real Soc. española Hist. nat., vol. 19, pp. 468–470. December, 1919.

——— Dos nuevos murciélagos frugívorus. Bol. Real Soc. española Hist. nat., vol. 20, pp. 106–108. March, 1920. (New: *Rousettus* [*Lissonycteris*] *crypticola*, from Fernando Po; and *Dobsonia remota*, from New Guinea.)

——— Dos nuevas ratas de la isla de Borneo. Bol. Real Soc. española Hist. nat., vol. 20, pp. 211–213. July, 1920. (New: *Rattus melinogaster*, from Bongon, northern Borneo; and *R. trachynotus*, from Kina Balu.)

Cooper, A. R. Trematoda and Cestoda. Rep. Canadian Arctic Exped. 1913–18, vol. 9, part G-H, pp. 1–27, 2 plates. Ottawa, February 4, 1921. (Trematodes and cestodes collected in *Phoca*, *Erignathus*, and *Canis*.)

Depéret, Ch., and F. Roman. Le Felsinotherium serresi des sables pliocènes de Montpellier et les rameaux phylétiques des Siréniens fossiles de l'ancien monde. Archiv. Mus. d'Hist. Nat. de Lyon, vol. 12, Mémoire 4, pp. 1–56; pls. 1–7. 1920.

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Gillespie, T. H. Annual report of the Zoological Society of Scotland for the year ending 31st March, 1920. Pp. 1–20. 1920.

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Hausman, Leon Augustus. Hair coloration in animals. Scient. Monthly, vol. 11, pp. 215–222. March, 1921.

Hinton, Martin A. C. Some new African mammals. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 368–373. April, 1921. (New: *Lutra maculicollis mutandæ* from British Ruanda; *Uranomys woodi*, Cholo, Nyasaland; *U. tenebrosus*, N'sana, Nyasaland; and *Cryptomys blainei*, Chisongwe, Luando River, Angola. The otter name is doubtless invalidated by one of Pohle's names, published in November, 1920, as noted above.)

Hollister, N. The names for two genera of African Artiodactyla. Proc. Biol. Soc. Washington, vol. 34, p. 77. March 31, 1921. (The bush pigs now called *Potamochœrus* should be known by the name *Koiropotamus* Gray, 1843; and the correct name for the hartebeests is *Alcelaphus* Blainville, 1816.)

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Little, C. C. Factors influencing the growth of a transplantable tumor in mice. Journ. Exper. Zool., vol. 31, pp. 307–326. October 5, 1920.

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Loveridge, Arthur. Notes on East African Mammalia (other than horned ungulates) collected or kept in captivity 1915–1919. Part I. Journ. East Africa and Uganda Nat. Hist. Soc., no. 16, pp. 38–42. February, 1921.

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McAtee, W. L. The "one-letter" rule for generic names in zoology. Amer. Nat., vol. 55, pp. 89–96. February, 1921. (An able defense of the one-letter rule.)

McGuire, J. A. In the Alaska-Yukon gamelands. Pp. 1–215; 16 plates. Stewart and Kidd Co., Cincinnati. $3 net. 1921. (An account of the hunting trip to the White River, Alaska-Yukon boundary, on which the type specimen of *Rangifer mcguirei* Figgins was obtained. Introduction by William T. Hornaday.)

Miller, Gerrit S., Jr., and N. Hollister. Descriptions of sixteen new murine rodents from Celebes. Proc. Biol. Soc. Washington, vol. 34, pp. 67–76. March 31, 1921. (New: *Echiothrix centrosa*, *E. brevicula*, *Rattus musschenbrœkii tetricus*, *R. raveni*, *R. r. eurous*, *R. palelæ*, *R. hoffmanni linduensis*, *R. h. subditivus*, *R. mollicomus*, *R. adspersus*, *R. nigellus*, *R. penitus*, *R. sericatus*, *R. rallus*, *R. hellwaldii localis*, *R. h. cereus*; all collected by H. C. Raven, on expeditions under the direction of Dr. W. L. Abbott, for the Smithsonian Institution.)

Nelson, E. W. The big game of Alaska. Bull. Amer. Game. Protective Ass., April, 1921. Reprint, pp. 1–7; 6 figs. 1921. (Address before the Seventh National Game Conference, New York City, January, 1921.)

Northcote, G. A. S. Baboons attacking children. Journ. East Africa and Uganda Nat. Hist. Soc., no. 16, pp. 60–61. February, 1921.

Paton, James S. Observations on the grizzly. Forest and Stream, vol. 91, pp. 155, 188. April, 1921.

Peck, Robert B. The renaissance of the beaver. Forest and Stream, vol. 91, pp. 152–154, 182–187. April, 1921. (Success of introductions in the Adirondacks.)

Pocock, R. I. The systematic value of the glans penis in macaque monkeys. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 224–229, 2 figs. March, 1921. (Revives the generic names *Lyssodes*, for *Macaca speciosa* and *M. fuscata*, and *Zati*, for *M. sinica*.)

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ROBINSON, HERBERT C. Two new Indo-Malayan rats. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 234–236. March, 1921. (New: *Rattus bandahara*, from Kina Balu, Borneo; and *R. panglima*, from Palawan, P. I.)

ROHWER, S. A. The nomenclature of supergeneric names. Journ. Washington Acad. Sci., vol. 11, pp. 106–109. March 4, 1921.

RUTLEDGE, ARCHIBALD. The otter: playboy of Nature. Country Life, vol. 38, no. 6, pp. 106, 110, 112, 114. October, 1920. (Account of otters in South Carolina.)

———Hunting deer in Dixieland. Forest and Stream, vol. 91, pp. 53–56, 91. February, 1921.

———Vendettas of the marsh. Outlook, vol. 127, pp. 379–382. March 9, 1921. (Contains notes on habits of the raccoon and white-tailed deer in South Carolina.)

SHUFELDT, R. W. Woodchucks and porcupines. Amer. Forestry, vol. 27, pp. 147–154, 180; figs. 1–15. March, 1921.

———The extermination of mammals. Their economic value; and their great importance to man through the study of their comparative anatomy. Med. Record, reprints pp. 1–20. May 7, 1921.

SOWERBY, ARTHUR DE C. Notes on the East Asiatic members of the species Sciurus vulgaris, Linn., with descriptions of two new subspecies. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 249–254. March, 1921. (New: *Sciurus vulgaris coreæ*, Corea; and *S. v. chiliensis*, Chihli, China.)

STOCKARD, CHARLES R. A remarkable explanation of polyembryony in the armadillo. Amer. Nat., vol. 55, pp. 62-68. February, 1921.

THOMAS, OLDFIELD. On a new genus and species of shrew, and some new Muridæ from the East-Indian Archipelago. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 243–249. March, 1921. (New genus, *Crossogale*. New species, *Crossogale sumatrana*, Sumatra; *Rattus dominator*, Minahassa, Celebes; *R. bontanus*, South Celebes; *R. marmosurus*, Minahassa, Celebes; *R. dammermani*, Wadjo, Celebes; *R. pesticulus*, Menado, Celebes; *Uromys talaudium*, Talaud Islands.)

———New foxes of the genera Cerdocyon and Pseudalopex from northern Argentina. Ann. and Mag. Hist., ser. 9, vol. 7, pp. 381–385. April, 1921. (New: *Cerdocyon tecumanus*, *C. thous jucundus*, and *Pseudalopex zorrula.*)

———On the cavies of the genus Caviella. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 445–448. May, 1921. (Three new subspecies of *Caviella australis.*)

———New Sigmodon, Oryzomys, and Echimys from Ecuador. Ann and. Mag. Nat. Hist., ser. 9, vol. 7, pp. 448–450. May, 1921.

TOYCEN, GEORGE. One buck's idea of a one-buck law. Wisconsin Conservationist, vol. 3, no. 1, p. 9, March, 1921.

[von Burg, G.] Von den schweizerischen Eichhörnchen. Der Weidmann (Bülach-Zürich), Jahrg. 1920, no. 48, p. 387. December 2, 1920. (New name: *Sciurus vulgaris subalpinus.*)

————Schweizerische Wiesel und Hermeline. Der Weidmann, Jahrg. 1920, no. 48, pp. 387–388. December 2, 1920. (New names: *Putorius ermineus alpestris* and *P. e. giganteus.*)

————Das boralpen Eichhörnchen. Der Weidmann, Jahrg. 1920, no. 51, p. 408. December 23, 1920. (Further remarks on his *Sciurus vulgaris subalpinus.*)

————Hermeline aus dem oberen Engadin. Der Weidmann, Jahrg. 1920, no. 51, p. 409. December 23, 1920. (The name *Putorius boccamela alpinus* is proposed for the ermine of the upper Engadin.)

————Münstertaler Siebenschläfer. Der Weidmann, Jahrg. 1920, no. 52, p. 419. December 30, 1920. (*Glis glis subalpinus*, provisional name for a specimen of *Glis italicus.*)

————Hausratten. Der Weidmann, Jahrg. 1921, no. 1, p. 7. January 6, 1921. (New name: *Mus rattus jurassicus.*)

————Münstertaler Haselmäuse. Der Weidmann, Jahrg. 1921, no. 3, p. 6. January 20, 1921. (New: *Muscardinus avellanarius mustairensis.*)

————Eine neue Spitzmaus? Der Weidmann, Jahrg. 1921, no. 3, p. 6. January 20, 1921. (New: *Crocidura sufflavidentata.*)

————Hausmäuse aus den oberen Tessintälern. Der Weidmann, Jahrg. 1921, no. 6, p. 5. February 10, 1921. (New: *Mus musculus airolensis.*)

Ward, Henry B. The conservation of game and fur-bearing animals. Science, n. s., vol. 53, p. 288. March 25, 1921.

Wright, Sewall, and Paul A. Lewis. Factors in the resistance of guinea pigs to tuberculosis, with especial regard to inbreeding and heredity. Amer. Nat., vol. 55, pp. 20–50. February, 1921.

CORRESPONDENCE

SEPARATE COPIES

To the Editor, Journal of Mammalogy:

May I appeal through you to my many friends among American mammalogists not to refrain from sending me separate copies of their papers in the Journal merely because they know I am a member of the Society, and therefore get the Journal.

Our great collection of separates here has been entirely built up out of the copies sent me, and these being arranged under author's names, and bound accordingly, the omission of contributions in the form of separates adds considerable probability to the chance of the papers being missed when work is done on the groups referred to, and certainly makes use far less convenient.

One has hitherto looked upon American naturalists as being the most liberal and the most certain in sending copies of their papers, but now alas the matter

is rapidly assuming quite a different complexion. I write in the first person in making this appeal but the question of course really affects all workers equally.

Yours, etc.

Oldfield Thomas.

British Museum (Natural History),
Cromwell Road, London, S. W. 7.
22nd February, 1921.

SAVE THE REDWOODS OF CALIFORNIA

Editor Journal of Mammalogy:

The Redwoods of California, *Sequoia sempervirens*, are among the oldest trees in the world. Their great size and height, the beauty of their feathery foliage, the grandeur and dignity of their towering trunks, the wonderful attractiveness of the half-lighted forest aisles give an impression which cannot be adequately described. That the inspiration of these things will be largely denied the generations of the future seems altogether likely unless prompt and adequate action is taken to preserve the Redwoods; for there are several important groves which, if they are to be saved at all, must be saved in 1921.

The pressing need for the preservation unspoiled of some fragments of wild nature is becoming increasingly apparent; and to few persons is this need more obvious than to the mammalogist or ornithologist who regularly takes the field. In California, Oregon and Washington, the far-reaching consequences of deforestation, which fall on the bird and mammal communities as well as on the trees, are all too evident. After the customary lumbering operations the landscape is a dreary and dismal place.

A determined effort inaugurated and led by Dr. John C. Merriam, of the Council of the American Society of Mammalogists, is being made to save some portions of the Redwoods. A non-profit corporation, the "Save the Redwoods League," has been organized, and it is proposed: (1) To rescue from destruction, for the enjoyment of this generation and those to come, adequate tracts of the *Sequoia sempervirens*, or Redwoods. (2) To establish through Federal aid a National Redwood Park, and through State aid a State Redwood Park. (3) To purchase Redwood groves by private subscription, and to establish memorial groves for individuals and organizations. (4) To obtain the protection of timber along the State highways now in course of construction in California. (5) To urge the State to purchase cut-over Redwood areas for reforestation.

Tangible accomplishments in which the League has had some part during the past year include the expenditure of over $100,000 in saving redwood groves along the State Highway in California, establishing a memorial grove to Colonel Raynal C. Bolling, the first American officer of high rank to fall in the World War, securing delay in cutting of areas designed for preservation, obtaining options on Redwoods lands along the South Fork of the Eel River (California), financing a survey for a National Redwood Park, gathering data for future use regarding the Redwood resources of the State, and engineering an effective publicity campaign. A strong organization has been built up and more than four thousand individuals have joined the League already.

Ultimately the League intends to secure a complete Redwood survey, including information concerning both species of Sequoia (*Sequoia sempervirens*, the Redwood, and *Sequoia gigantea*, the Big Tree). It is desirable that the birds and mammals of the Redwood habitat be investigated together with the trees. In view of Hofmann's findings (Ecology, vol. 1, 1920, pp. 49-53) regarding rodents and the reproduction of Douglas Fir one might almost expect to discover further significant relationships.

Those interested in the objects of the League can help by joining the organization, and promoting the prosperity of the movement in other ways. The Secretary-Treasurer of the League is R. G. Sproul, University of California, Berkeley, California; the dues for annual members are two dollars a year. It would seem appropriate that the American Society of Mammalogists take official cognizance of this movement and offer the encouragement of its moral support at least through the medium of resolutions adopted at the next annual meeting.

Walter P. Taylor.

Biological Survey, La Jolla, California.

THE THIRD ANNUAL MEETING OF THE AMERICAN SOCIETY OF MAMMALOGISTS

The third annual meeting of the American Society of Mammalogists was held in the United States National Museum, Washington, D. C., May 2–4, 1921, with 67 members in attendance,—approximately $\frac{1}{8}$ of the total membership of the Society. Among other business matters it was voted that the Society affiliate with the American Association for the Advancement of Science; and that two additional committees be appointed: one on Marine Mammals; the other on Economic Mammalogy. Prof. E.-L. Trouessart, Muséum National, Paris, France, was unanimously elected an Honorary Member. The following rule was adopted by the Society: Rule III. Delinquents. A. Members whose dues are in arrears for more than one year shall not be entitled to receive the Journal of Mammalogy. B. The names of members whose dues are in arrears for more than two years shall be presented to the Directors for action.

The report of the Corresponding Secretary showed a total of 527 members in the Society, of which 99 were elected at the present meeting, and 41 were delinquent for 1920 dues. There had been 2 deaths and 11 resignations since the last annual meeting. The total distribution of the Journal of Mammalogy, including subscriptions, May 3, 1921, was 550.

The Society can take pride in having established a creditable magazine without a single financial donation toward its publication or general expenses. This has been done at a critical period in industrial history and at a time when printing costs were almost prohibitive. It has been possible, however, largely through the Charter Members, who willingly paid membership dues for the year 1919, yet received only one number of the Journal during that year. With a normal increase in the number of members and subscribers we can hope to continue to publish under present conditions between 200 and 250 pages and 10 half tones a year. Indications are that we shall soon be receiving first-class manuscript in

quantity sufficient to publish 400 pages a year. Is the Editor to be placed in a position where it will be necessary for him to refuse valuable contributions? It would seem that the Society could ill afford to sanction such a predicament. Diffusion of knowledge is as essential as its creation. Immense endowments are given to be devoted to research, investigations, and explorations. Comparatively small sums set aside as permanent publication funds would make available some of the results now buried in manuscripts. It is, therefore, essential to the best interests of the Society, the Journal, and everybody concerned, that definite and positive action be immediately taken to raise a Permanent Publication Fund. Any amount raised would actually be worth double the amount to the Journal because of the assured increase in the number of subscriptions which would follow the improvement in the Journal.

The program follows:

MONDAY, MAY 2

10:00 A. M.

Meeting of the Board of Directors

Afternoon Session, 2:00 P. M.

1. Remarks on certain mammals of Panama. E. A. Goldman. Twenty minutes. Illustrated by lantern slides and specimens.
2. A singing mouse. H. H. Lane. Five minutes.
3. Disposition and intelligence of the orang-utan. W. H. Sheak. Fifteen minutes.
4. The California elk-drive of 1904. C. Hart Merriam. Fifteen minutes.
5. Some observations on beaver culture with reference to the National Forests. Smith Riley. Thirty minutes.
6. Progress in mammalogy during 1920. General discussion for members. Led by T. S. Palmer. Sixty minutes.

Evening Session, 8:15 P. M.

7. A motion picture record of the animal collections of the Washington and Philadelphia Zoological Parks. (Made with the camera invented by Carl E. Akeley.) Arthur H. Fisher.

TUESDAY, MAY 3

Morning Session, 10:00 A. M.

8. Geography and evolution as pertaining to the kangaroo rats of California. Joseph Grinnell. Twenty-five minutes.
9. Nerve-endings of the maculae and cristae acusticae. H. H. Lane. Ten minutes. Illustrated by chart and demonstrations.

Business Session, 10:45 A. M.

Afternoon Session, 2:00 P. M.

10. Life histories of African squirrels and related groups. H. Lang. Forty minutes. Illustrated by lantern slides.

11. (a) Meaning of California records for buffalo. (b) The range of mountain sheep in northern California. C. Hart Merriam. Fifteen minutes. Illustrated by lantern slides.
12. Habits of the mammals of Celebes and Borneo. H. C. Raven. Thirty minutes. Illustrated by lantern slides.

WEDNESDAY, MAY 4

Morning Session, 10:00 A. M.

13. Present status of some of the larger mammals of Canada. R. M. Anderson. Twenty minutes. Illustrated by lantern slides.
14. Observations on certain specialized structures of the integument of primates. (a) Carpal sinus hairs. (b) A sternal gland in the orang-utan. Adolph H. Schultz. Twenty minutes. Illustrated by lantern slides.
15. Improved methods of trapping small mammals alive. Vernon Bailey. (Presented by E. A. Goldman.) Fifteen minutes. Illustrated by traps and specimens.
16. Life-zones of southern Ecuador. H. E. Anthony. Thirty minutes. Illustrated by lantern slides.
17. Remarks on the distribution and relationships of the North American chipmunks. Arthur H. Howell. Twenty minutes. Illustrated by lantern slides.
18. Some significant features of economic mammalogy. W. B. Bell. Twenty minutes.

Afternoon Session

At 1:00 P. M. members and their wives were entertained at luncheon at the National Zoological Park by the administration of the park and the Washington members. A short business session followed the luncheon, and a trip through the park under the direction of the Superintendent, Mr. N. Hollister, closed what had been, in spite of inclement weather, a most interesting and enjoyable meeting.

Hartley H. T. Jackson.

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The American Society of Mammalogists

Founded April 3, 1919
Incorporated April 29, 1920

E. W. Nelson, *President*
Wilfred H. Osgood; Gerrit S. Miller, Jr., *Vice-Presidents*
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ON THE HABITS OF TRICHOSURUS VULPECULA

By FREDERIC WOOD JONES

[*Plate 13*]

There are but few Australian marsupials to which the term common or abundant can properly be applied today. It is difficult for any mammalogist, who has only a text book knowledge of the Australian marsupial fauna, to realize how rapidly are the closing scenes of extermination being enacted. More certainly, more swiftly, and withal more silently are the indigenous mammals of Australia passing into the category of the extinct, than are the inhabitants of any of the other large land masses of the globe. Large, conspicuous, and commercially valuable mammals are in some danger of extermination everywhere. But Australia holds this distinction; she is losing all her mammalian fauna from the largest and most conspicuous to the smallest and the most obscure.

There are several factors which combine to effect this wholesale destruction. First, the introduced carnivores, the fox and the cat, can outwit and destroy the native fauna wherever they come into contact. Second, the rabbit, the sheep and the cattle have raised the standard of competition for vegetable food to such a pitch that the herbivorous marsupials cannot survive in the struggle for existence. Third, such arboreal forms as are phytophagous, and are not subjected to this competition, are mostly valuable fur bearing animals, and it must be remembered that the fur trade of Australia is wholly destructive. The remaining factor is one due to geographical conformation and climate. In Asia, in Africa, in America and in Europe extermination of mammalian faunas is comparatively slow, since there are places

in the interior, wild regions in mountains, forests, swamps, and uncultivated yet fertile districts to which the animals, driven before advancing civilization, can retreat. So far as the western and southern parts of Australia are concerned these natural sanctuaries do not exist. The interior of the continent is not a place of refuge for the native fauna; it is a place in which competition for every blade of grass is raised to a standard unattainable by the very unsophisticated marsupial.

It may be said that the Australian marsupial has two slender chances of self preservation. It may be driven to the interior where in times of drought the severity of the struggle for food and water is marked by the carcasses of the introduced herbivores that have perished. Or it may be driven to the more populous districts where food is in comparative plenty; but where man, cats, and foxes are all intent upon compassing its destruction.

Among the animals that have chosen this last alternative, *Trichosurus vulpecula typicus* stands out conspicuously. Universally, and certainly permanently, known throughout Australia as the "opossum," this phalanger is to a great extent a suburban animal. In Adelaide at any rate, the opossum (for it is useless to persist in naming it the common, or vulpine phalanger) has adapted itself to modern circumstances better than any other marsupial. Wherever sufficient native timber has been permitted to remain, so as to afford a shelter, there will opossums be found. More than this, the animal has to a large extent adapted itself to become independent of the big eucalypti, in the holes of which it has its natural home. It has learned that the space under the roof of the usual type of suburban bungalow affords an excellent shelter and in such situations it freely takes up its residence. In this opossums have earned the ill will of the suburban householder, as their activities are nocturnal and noisy.

They are also in ill repute since disfiguring stains on ceilings often mark the site of their residences above, and contamination of gutters is an important thing in a place where water collected from the roof is of the utmost value. Moreover, the fondness of opossums for rose buds, and for the fresh young shoots of vines and fruit trees renders them unpopular with the suburban gardener. Practically every man's hand is against them, and yet they survive in a surprising way right up to the limits of the town.

Trichosurus is the only marsupial which seems to possess sufficient adaptive plasticity to be able to compete for survival in a suburban environment with any degree of success. And yet it must be owned

that an intimate acquaintence with the animal produces the impression that an inoffensive and stupid simplicity is the key note of its psychology. It is probably this simplicity which renders all opossums more or less tame, for there is very little difference in the degree of docility between a fresh caught adult and an animal which has been born and bred in captivity. A wild male has been in the habit of paying evening visits to my captive specimens, fearlessly coming into the outhouse in which their cages are placed. This visitor would permit me to approach and stroke it, but would not allow itself to be grasped or picked up. Freshly caught animals show practically no resentment of captivity, and when placed in a temporary cage are very reluctant to leave it for a larger and more comfortable one.

When handled, even when chased and captured, they, like most marsupials, remain silent; they will bite and scratch, and defend themselves stoutly, but as a rule they utter no cry. But though they are thus voiceless when molested by man, they are extremely noisy in their own domestic quarrels. The ordinary sound expressive of resentment, and a prelude to all encounters, is a long drawn inspiratory hiss. This hiss may die down as a harsh grunt, but when continued becomes increasingly high in pitch and may be modulated into a harsh cry, which rises to a raucous screech when the animals are fighting. During the breeding season, when fights are most common and the animals are most vocal, the male produces a curious sound like a sharp licking of the lips and a click of the tongue. So far, I have not heard a female produce this sound. The cry of the young when removed from the mother is extremely loud and quite peculiar, and can be described best by saying that it is so like the voice of the common South Australian tree frog that it is almost impossible to distinguish it from the frog's voice.

In fighting among themselves the oppossums use the claws of the fore feet far more than the teeth, and although they often inflict scratches on each other and remove quantities of hair, even the noisiest encounters usually result in no great damage to the opponents. In performing the toilet of the fur, the palmar surfaces of the hands are licked, and the face is washed after the familiar manner of the cat. The fur of the rest of the body is combed with the syndactylous digits of the foot. The syndactylism of the digits is most certainly, in all the syndactylous marsupials that I have watched, a specialization of structure adapted to the toilet of the hair. The second and third pedal digits, with their parallel nails, constitute a hair comb, and as

such they find their functional homologues in the procumbent lower incisors of the lemurs, the crenated lower incisors of *Galeopithecus*, and the specialized hair-scratching nails and claws seen in many mammals.

The hair is raked through by this specialized hair comb, and then the comb is cleansed by the tongue and teeth. Not only is this toilet-use the obvious function of these digits, but it is the only function that they possess, so far as I can learn after hours of watching at all times and seasons.

Trichosurus is a skilled, but by no means a nimble climber. When alarmed it seeks to escape rather by remaining motionless than by the exhibition of any feat of exceptional activity. Its movements, as a rule, are slow and cautious, and great reliance is placed upon the grasp of the prehensile tip of the tail. It is rare to see the tail grip released until the creature is well satisfied that it has a firm hold by some other member. The foot with its highly specialized and nailless big toe is capable of taking a very firm hold, and descent is always made head downwards. The hands are always used for gathering food, and for holding it to the mouth when eating. Opossums are crepuscular feeders, eating directly they wake at dusk. Less than many other marsupials are they dependent upon the native Australian vegetation, for though they relish the pungent leaves of the eucalypti, they will eat almost any green leaves, and their great fondness for flowers is one of the reasons for their unpopularity. They drink but little and are quite independent of water when a plentiful supply of fresh green vegetation is to be had. When they do drink, they lap the fluid with great rapidity. Like wallabies and bandicoots they have the strange habit of licking their fur in very hot weather. The fore limbs especially are always kept wet when the animal is suffering from the extremely high summer temperatures.

Of its means of keeping in touch with its environment its auditory sense and its tactile sense apparently take first place. Its sense of hearing is remarkably acute. The long ears are pricked and mobile when the animal is active, but are folded during repose. The tactile areas of the rhinarium and the naked pads of the hands and feet, as well as the numerous sensory vibrissae on face and limbs, are evidently of the highest functional importance.

Vision, even during the time of the animal's highest activity, does not appear to be at all keen, and seems to be of secondary importance only. I have had a fine male, three parts grown, in which there was complete double congenital cataract. This specimen came to grief

by appearing abroad in full daylight and being caught by dogs, but from its fine condition it was evident that it had no difficulty in finding its way about and obtaining its food. As is not at all unnatural in an arboreal animal, the sense of smell is by no means highly developed, and it seems to be of but little importance in obtaining food or in avoiding enemies. The human scent appears to be in no way objectionable to the Australian opossum. It is astonishing how long it will take a captive animal to discover food placed in its cage when it is so situated as not to come into immediate contact with it. There is no doubt that captive animals can recognise the individual who habitually attends to them, but beyond that there is no advance in what may be termed the education of captivity.

The breeding season is in June. I have not been able to gather one scrap of evidence that the animal breeds twice in the year, though it is commonly asserted to do so. The animals begin to breed in the year following that in which they are born. The advent of the breeding season is marked by a conspicuous increase in the size of the testes in the male. So far, I have observed neither copulation nor birth, but a series of notes upon the reproduction of a pair in captivity may be of interest.

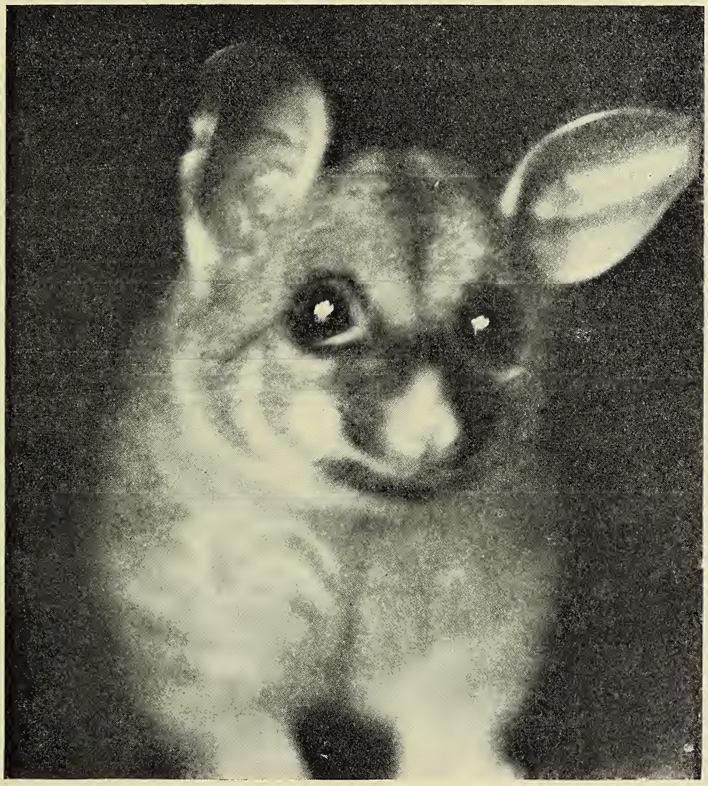
An old male, and a female of the previous year, were put together in May. The female was considerably smaller than the male, and for a month he bullied her rather badly. In June they were on better terms; but towards the end of the month the female became very savage with the male, and would not permit him to come near her. On June 23 the female was noticed licking her pouch, the opening of which she dilated with her hands. On June 25 she was seen to stretch the pouch open with her hands, and thrust her nose into the opening. This process was watched repeatedly; she would not permit me, however, to examine the pouch. Within a few days the quarrelling became so constant, and the attentions to the pouch so frequent, that on July 3 the male was removed from the cage. On July 17 I left Adelaide, and up to that time I was unable to examine the pouch or even to see into it while she opened it to lick it or thrust in her nose. On September 17 I returned. The female was walking with a distinctly waddling gait, and the pouch was obviously enlarged. She now permitted me to feel the exterior of the pouch, and the contained embryo was distinctly palpable. I could however get no view of it since the animal has voluntary control over the musculature of the pouch, and she contracted the mouth whenever I examined it.

On September 19, whilst she was feeding quietly, the mouth of the pouch was seen to dilate, and a part of a red, hairless embryo was seen. The pouch however contracted whenever I touched it. On September 23 the pouch again opened whilst she was being watched, and the embryo, now dusky with developing hair, was observed for a long while. At this stage, when the body first becomes clothed with hair, the pelage is of a uniform dusky brown. On October 4 the young one kicked both its hind legs out of the pouch, and when it had withdrawn them left its tail protruding. On October 9 it first left the pouch for a very short time. Its eyes were open; its dorsal surface was brown and its ventral surface yellow. The mother cleaned it by licking, as a cat cleans a kitten; she restrained its movements with her hands, and thrust it back into the pouch with her nose. It reappeared outside the pouch on the 10th, but for a short while only. For the next 4 days it did not come out of the pouch while the female was under observation, but on the 15th it came out an spent most of the day closely folded against its mother's ventral surface. On the 25th the mother first came out to feed leaving it behind in the sleeping box.

On the next day the young one was taken and examined and the mother showed no signs of resentment until it cried. It was a male, and it was difficult to believe that it and its mother belonged to the same species. It was covered with fine and close hair of a red brown colour, its dorsal surface being brown and its ventral surface a fine bright yellow tan. It clung remarkably tightly to its mother's dense fur, gripping the fur with its sharp claws, and encircling her body with its prehensile tail. By the end of October it could feed itself, but although growing rapidly it still spent a great part of its time in its mother's pouch. During the first week of November she showed signs of impatience with it and turned it away from the pouch with her nose when it attempted to get inside; though she still permitted it to insert its head for the purpose of suckling.

On November 16 I left Adelaide, and on my return on the 27th the young one was independent of its mother. Its appearance had altered. Its coat had become a good deal more woolly, and the grey tint of the adult was apparent along the middle of the back. This canescence appears to take place without any moult. By the end of the year it had completely lost its brown and tan colour, its coat had become gray and woolly all over, and it was in all respects save size similar to the adult. By the end of January it was practically as large as its mother.

Female Trichosurus vulpecula with Pouch Opened and Showing the Large Young



Adult Female Trichosurus vulpecula
Photos by F. Wood Jones

(Jones: Habits of Trichosurus vulpecula.)

It is usually said that four nipples are present in the female of *Trichosurus.* It is well known that the number of nipples is subject to considerable variation in several Australian marsupials; no specimen of *Trichosurus* that I have so far examined has had more than two. It is also often said that two young are produced at a time. I have handled a very large number of embryos and so far have not met with a case in which more than one was present.

University of Adelaide, Adelaide, South Australia.

THE OCCURRENCE OF A STERNAL GLAND IN ORANG-UTAN

By Adolph H. Schultz

[*Plate 14*]

During the examination of a fetal male orang-utan (crown-rump length 145 mm.),[1] in which the lanugo was still for the most part microscopic, the author's attention was attracted to a small circular pit in the middle of the smooth skin of the chest. This pit was easily visible and a closer study proved beyond doubt that it was not due to injury, but was evidently a natural opening in the skin. An older male orang-utan fetus, near term (crown-rump length 230 mm.),[2] showed the same pit at a corresponding place on the chest (see figure 1). From this specimen an area of skin, including the pit, was removed and sectioned. The histological examination of the sections cleared up the nature of this structure. It was found to be the opening for a considerable number of large sebaceous glands conglobated beneath. The pit is situated in the midsagittal plane, slightly above a line connecting the nipples, and overlies the manubrium sterni. Based upon their location the gland may be termed *sternal gland* and its opening *sternal pit.*

The examination of a total of twenty-three specimens of orang-utan ranging in age from fetuses to very old specimens and including both sexes, revealed some interesting facts regarding the occurrence of this sternal gland. The author wishes to express his sincere thanks to Mr. G. S. Miller for his kind permission to study five preserved orang-utan fetuses and newborns and a number of adult skins in the National Museum; to Mr. N. Hollister for the opportunity to examine the orang at the National Zoological Park; to Mr. R. L. Ditmars for information regarding the orang at the New York Zoological Park; and to Dr. E. Huber for his careful notes on some preserved orangs of the University in Zürich.

The gland was found to be present in 12 out of 13 males and in 2 out of 10 females. The only male in which it was missing was a very old specimen, and this, together with the fact that in the fairly old orangs the pit was relatively much smaller than in the juveniles, would indicate that the gland degenerates gradually with advancing age. The only two females in which the pit was present were juveniles, the fetal,

[1] No. 143597 U. S. Nat. Mus.
[2] No. 153973 U. S. Nat. Mus.

infantile, and adult females showing no trace of it. It seems probable, therefore, that, while the sternal gland may develop in the female, it apparently does so in only a small percentage of cases. Its constant presence in males, with the exception of very old animals, and its sporadic occurrence in females tends to substantiate the assumption that we have to deal here with a secondary sexual character. However, the fact that this gland is found as early as the middle of fetal life does not conform readily to this theory.

The sternal pit is most evident in fetuses, where its umbilicated opening reaches a diameter of 2.5 mm. The skin patterns are arranged in circles around it and become very much finer and smaller immediately surrounding it. In juvenile specimens a low circular wall is frequently found at the edge of the actual pit. At this age and later most males have a round, dark brown pigmented spot, sharply circumscribed, with the sternal pit in the center. In the fetus, also, sections show a slight increase in pigment at the periphery of the pit, but a large accumulation of pigment does not occur until later in life. In some instances the sternal pit was not circular but oblong, in which case the longest diameter was always horizontal. Its depth in juvenile specimens was in several instances 2 mm. and amounted in one case to even 3.5 mm. In old males the pit is very difficult to find, due to the fact that it is almost always covered by long hair and hidden among the wrinkles of the skin or beneath the folds of the laryngeal pouches. The difficulty of detecting the gland in the full-grown animals, where the pit also is relatively smaller and shallower than in juvenile and fetal specimens, probably accounts for the fact that it has not, so far as the author can ascertain, been previously described. An important feature of the sternal gland is its constant position, which varies only within a few millimeters above or below a line connecting the nipples, and which always lies exactly in the midsagittal plane.

Figure 2 shows a section through the skin containing the sternal gland of the fetus shown in figure 1. The sections were cut in a perpendicular direction. One can see a canal emptying into the bottom of the spacious pit; beneath lie the large sebaceous glands. A study of all the sections showed that a number of these glands have one joint outlet, but there are also many others with minor separate openings into the pit. The sweat glands surrounding the pit seem to be unusually numerous and of more than average size. In several cases microscopically fine hairs can be observed on the edge, and in one instance at the bottom of the pit.

In one juvenile male orang, in the National Zoo, one can feel the glandular body, which is approximately the size of a pea, beneath the pit. After some palpation a tiny drop of apparently crystal fluid exudes from the opening.

In conclusion it may be stated that during the examination of a considerable number of preserved bodies of fetuses and adults of many different species of monkeys and apes no trace of anything comparable to this sternal gland in the orang-utan was found. It seems certain that this gland is not present in the adult chimpanzee, gorilla or gibbon, nor in the last mentioned in a fetal stage. It is impossible at present to say what purpose the sternal gland in the orang may serve. The odor of its secretion and the time of its maximum functioning would probably throw light on this question. An accumulation and concentration of glands in the region of the chest is known to occur in marsupials (*Myrmecobius*, *Didelphis*, *Trichosurus*, and *Petaurus*), where their opening lies for the most part in a hairless region. Some forms of Chiroptera likewise have large glands in the middle of the chest. In these mammals also, the glands are more strongly developed in, or even entirely restricted to the male.

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Fig. 1. Front View of Male Fetus of Orang-utan Showing the Sternal Pit

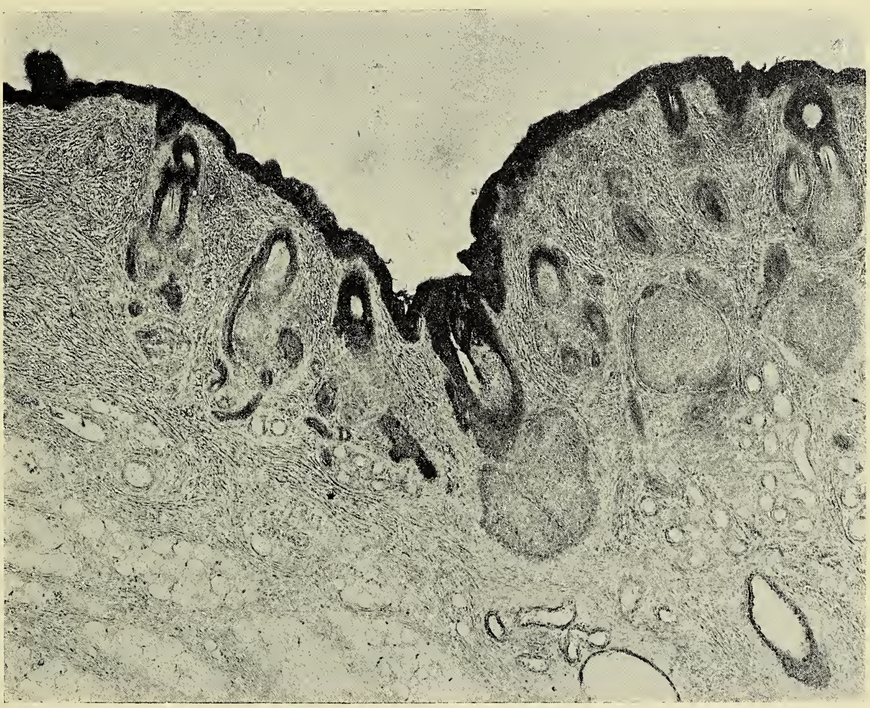


Fig. 2. Perpendicular Section Through the Sternal Pit and Gland of the Orang Fetus Shown in Figure 1. 45 × Enlarged

(Schultz: Sternal Gland in Orang-Utan.

SOME OBSERVATIONS ON BEAVER CULTURE WITH REFERENCE TO THE NATIONAL FORESTS

By Smith Riley

The Federal Government has been entrusted with the responsibility of protecting and bringing to their highest use 156 million acres of public forest land in this nation. The protection, culture and use of the trees, of course, is the first purpose. However, when full consideration is given to the variety of the types embraced in these reservations, it will readily be seen that the possibility of cultural use covers an enormous field. Obviously, in the establishment of reservations to cover certain types of land, full recognition must be give to the place these lands occupy in national use and no opportunity should be lost to have them do their part in economic production. There are many uses to which lands producing trees can be put without interfering with the principal purpose.

It has been said that the demand for fur has existed since primitive man sought skins to shield his body from the cold. This demand is fundamental and will endure while man inhabits the earth and furs are to be had. Its strength can be judged by the volume of trade it supports. In 1913 the dressed and manufactured furs imported into the United States were valued at more than $15,000,000. North American furs annually marketed in the United States and England have an approximate value of $60,000,000. These figures show the commercial importance of fur, and in addition to this the fur trade furnishes a livelihood for many thousands of workers in the factories and stores of the country.

The fur resources of the United States have been destructively used throughout the whole life of the nation. In the history of the fur trade there is not one instance of constructive action looking to the building up of this valuable resource. In Chittenden's accounts of the far western trade he repeatedly refers to the detrimental results in the destructive methods employed in the development of the trade. In the early days the Government refused to limit the competition which did more than anything else to decrease fur production. Of later years as some states passed laws controlling the taking of fur-bearing animals nothing has been done to define fur production areas or to stabilize production by ascertaining that amount of fur of the different kinds which a given region should produce. That such action was entirely possible is shown in the experience of Canada,

where the strife of rival companies bid fair to destroy a vast resource when steps were taken to limit the activities of each company to a given region. This act alone, aside from any laws controlling the catch, did much to stabilize the industry through permanent interest in production from a given region over a long period of time. The trappers dealing with the companies were encouraged to leave animals for breeding. Later, I believe, laws were enacted to enforce this very point.

In many of the states where there are National Forests trapping beavers is prohibited, though provision is made to take such animals as destroy property. Little interest is taken in the protection of fur-bearing animals, with the result that applications to take beavers on the grounds of active damage are not investigated, resulting in much taking of beavers without compliance with the laws for protection.

Where there are closed seasons or where trapping fur can be carried on only under permit, no attempt has been made to ascertain the productive capacity of the region, with the result that, even with the closed seasons upon some of the more important animals, in many of the states, the fur resources of the United States have steadily diminished during the last half century, far beyond any justification. Present conditions point beyond a doubt to further shrinkage. The decrease has been in the quantity of the better pelts and not in the total value of the catch.

Beavers, otters, martens and fishers have disappeared from much of their former range, and even minks, raccoons, and skunks have become scarce in some localities. The result is that many kinds of thinner furs have come into the market, with an almost prohibitive price upon beaver fur. The following statement is taken from Chittenden's History of the Fur Trade in the Far West:

> The great importance of the beaver in the life of the hunter and trapper arises almost entirely from the commercial value of its fur, which is one of the finest that nature produces. At this early period in particular it was in great demand. An average price was four dollars per pound and as the little animal carried from one to two pounds on its body the premium for its destruction was from four to ten dollars according to the size and the prevailing price of furs. As the streams of the west—of the whole country for that matter—originally swarmed with these animals in numbers that rivaled the illimitable buffalo herds of the plains, it will be readily understood what a mine of wealth here lay open to the industry of the trader and the trapper.
>
> Every stream of the west was as rich as if sands of gold covered its bottom—a richness moreover, which if gathered with judgment and not to the degree of extermination, would renew itself by natural increase.

The beaver also supplied another article of commerce, a secretion from two small glands of the body. This was always known in the commerce of the mountains as castorum. In the arts it is more commonly called castor. In the mountains its value was about three dollars per pound. The castorum was used as the beaver's bait, and thus the little animal itself supplied the means of alluring its race to destruction. The extensive use of the beaver fur in the early years of the century caused an increase in exportation from America to Europe, reaching as high as 200,000 skins annually. This great draught on the supply led to the rapid extermination of the beaver.

In Mr. Chittenden's book, The Yellowstone, is the following statement: "but a business carried on with such relentless vigor naturally soon taxed the resources of nature beyond its capacity of reproduction. In regions under the control of a single organization, as in the vast domains of the Hudson Bay Company, great care was taken to preserve the fur-bearing animals from extinction. In the United States territory the excess of competition made any such provision impossible."

There is not an instance in any section of the country of a departure from the original destructive policy. It is true, protective laws have been passed by many of the states but under the existence of the laws there has been no systematic study of a plan for stable production. The growing sentiment for wild life preservation coupled with the realization of the place beavers fill as water conservers in the irrigation regions has done much to direct attention towards better methods of protection. This has been particularly noticeable in those states where there has been a closed season and the animals have increased to such an extent that a cry has been raised of damage to crops. Those who wish to prey upon the beaver seek to gain their ends by noising their destructive tendencies.

There is no question about the damage done by beavers to both ditches and crops, so their development in an agricultural district requires constant attention to prevent damage. In face of this fact there are many ranchmen or agriculturalists who accept the trouble entailed by the animals for the satisfaction of having them upon their property.

In Colorado, which has had a closed season for many years, with a provision in the law for taking such animals as cause damage, the beavers have, in spite of the wholesale disregard of the law, increased to such an extent that repeated efforts are being made to change the law so that the animal can be taken without restriction. This shows their persistence and what might be done with them where

suitable culture areas are available. There is much stream area in the range of ditch-heads and cultivated lands where beavers can exist to advantage with little property loss. I do not believe there exists any general sentiment among those interested in lands of this type for the complete elimination of the animals. There are those who deplore the property loss and would destroy the beavers completely, feeling that property should be first and seeing no value in the animals. There are those who covet the products of the beavers and agitate the damage feature to gain the assistance of those who would destroy the animals to protect property. Considering the failure of two legislatures to open the season, I feel that those in favor of protection are in the majority.

If there were to be considered only the stream-reaches in the range of ditches and cultivation, the general conditions would offer many features encouraging to a study of a workable plan for production. When we add to this the many miles of suitable water well supplied with food and entirely removed from conflicting interests, the possibilities for a substantial return from the lands and the development of an industry which will not interfere with the land production in other ways appear very feasible. The National Forests are for the most part mountainous lands which will remain in a wild state and they therefore offer excellent culture areas for fur animals. Another point which should be given full consideration is that the forest lands controlling the upper waters of all the principal streams in the mountain country are the natural culture grounds for these creatures. Besides, the nature of the administrative units creates an obligation for the complete production from the lands.

The present status of the beaver in the Cochetopa Forest in Colorado is an excellent example of what can be done in the average mountain region suitable for beaver culture. It is estimated that this Forest which covers some 900,000 acres contains 12,000 animals distributed over about half the available water area suitable for production. As the animals were causing damage to ranch property in one locality near the forest boundary, a plan was drawn up for coöperative trapping with the state game department. It provided for the extermination of the beavers where they were committing actual damage; for their increase unmolested in streams of the Forest not fully stocked; and finally for the transplanting of the beaver to streams where they do not at present exist, and where food and other conditions are thought favorable for their propagation.

The trapping was done on Cochetopa Creek. This stream, about 15 miles in length within the Forest boundary, has an almost continuous series of dams from the boundary to above timber line. Below the Forest there are several ranches where the beavers were causing damage. The damage consisted in flooding hay meadows and obstructing irrigation ditches, and was investigated by the local forest officers before a recommendation for the trapping was submitted. The stream, therefore, afforded a combination of both conditions under which trapping was justified; that is, a fully stocked stream and also a locality where the ranchers were suffering actual damage.

Upon the recommendation of the Forest Service, a trapper was sent by the state with instructions to work under the direction of the forest supervisor. When he arrived the latter part of April, the work was outlined to him as follows: (1) To try to exterminate the beaver on the ranches below the Forest where the owners desired this to be done, and for a distance of half a mile within the Forest to prevent interference with a big irrigation ditch; (2) to reduce the number for a distance of about five miles within the Forest, to give the remainder room to increase without working down upon the ranches and causing an immediate recurrence of damage; (3) to leave those on the upper courses of the stream unmolested with the idea that, if the trapping proved too heavy or caused the beaver to migrate to another locality, they would work down the stream as they increased, thus restocking the portion trapped.

There was no actual evidence that heavy trapping might cause the animals to migrate, but the work being new and in a somewhat experimental stage, it was thought best to leave them undisturbed on a portion of the stream.

Ice prevented operations when the trapper arrived, so he put in his camp and looked over the ground in preparation for the work. He started trapping about the first of May and trapped until the first of June. During this time he caught 132 beavers with No. 4 Newhouse traps, using twenty.

In regard to costs it is regretted that actual figures can not be given as the local forest officers did not know definitely whether the trapper was paid a salary or was allowed a part of the hides. However, regardless of how the state handled the matter the net revenue must have been considerable, in view of the size of the undertaking. The local forest office was informed that some of the hides brought as high as $33, and that the total gross returns were $3,000. Assuming that

the state was able to hire the trapper for $100 per month, and that the expense of the trip was about $100 in addition, which seems reasonable, the cost of trapping the beavers would be about $1.50 each.

The trapping was not sufficiently thorough, on and in the immediate vicinity of the ranches, in that the beavers were not exterminated, and they may again become a source of damage. However, if trapping can be done at frequent intervals on the stream, this will likely be obviated.

Along the five-mile stretch within the Forest, there is a noticeable reduction in the number of beavers, but this is not as marked as might be expected. Observations made the following fall indicate that with three or four exceptions all dams within the stretch are still inhabited. This would indicate that the trapping within the Forest has been sufficiently conservative; and if desired, the stream could be safely trapped again next spring without reducing the stock below normal; that is to say, probably not more than the normal annual increase for the stream has been trapped. It is planned to make further observations of the results next summer, and to defer recommendations for further trapping on this stream for the present. It is planned, if the state can be induced to send one, or preferably two trappers, next spring to undertake similar work on two other creeks, both of which are heavily stocked and along which some damage to ranches is occurring.

It might be added further that the estimate of the number of beavers in Cochetopa Creek and tributaries was 1,200, and that the apparently small reduction in numbers following last spring's trapping would indicate that this estimate is conservative. It is more likely under rather than over the actual number. It might also be added, that 20 beavers were trapped from this same locality on the stream under permits to local ranchers, the fall before the state trapper undertook the work, making the total number trapped from the stream during the past year 152.

The State trapper failed to take any of the beavers alive for planting, so a permit was issued by the state to the forest officers to do the live trapping.

It was planned to use the woven-wire-corral method of trapping the beavers, but owing to the lateness of the season and probable length of time it would take to get them in this way, ordinary steel traps were resorted to and they were visited at short intervals so that any animals caught would not injure themselves. It is realized that this was a very

crude way to do the work, and might result in considerable injury to the specimens taken. Fortunately this was not the case with the two trapped, and both of them were removed from the traps without suffering severe injury.

An ordinary box was made 2 x 2 x 3, with sliding door, for transporting the animals. One quarter inch cracks were left between the boards to allow for air. It was lined with chicken wire to prevent the animals from gnawing, and both were placed in the same box. They made no attempt to gnaw out and caused very little disturbance while in the box, being comparatively docile after being once captured. One was inclined to fight while being removed from the trap, until released from it. The first one was placed in the box directly from the trap; the second one was carried to the box in an old gunny sack. It scratched around some, but did not attempt to gnaw its way out. The two captured were two-year-olds. In trapping the pair an extra male was caught. It was transferred to Carnero Creek with the idea that we might later be able to get a mate for it, but we were unable to do so.

The beavers were transported by automobile from the place trapped on Cochetopa Creek to the upper Saguache Ranger Station, and thence by wagon about 10 miles to where they were released in Houselog Creek. The first beaver captured was in the box three days and two nights before being released. He apparently suffered no injury from the confinement or from the long period out of the water. Both were in good condition when released in Houselog Creek.

The beavers were released just above the upper ranch on Houselog Creek. The sentiment of the local ranchers and homesteaders along the creek is favorable to the propagation of beaver, they feeling that if the stream becomes stocked, they will benefit through the holding back of the water, making more for irrigation in the late summer.

It is, of course, too soon to predict the result of the work, but it is thought that it will be successful. There is an abundance of aspen along the stream for food. Two or three weeks following the release, little was seen of the beavers, but aspen cuttings were observed at different places along the creek. They apparently wandered around considerably before settling down; but the last observations of Ranger Gallegos showed that they had established themselves just above the fence of the upper ranch on the creek, and had built a den in the bank. They have not built a dam, but it is doubtful if this is essential, since some of the beavers in this locality do not construct dams.

When the beavers were released from the crate and turned into the creek, they were apparently somewhat bewildered. One started up the creek and the other down. In order to keep them together, Ranger Gallegos headed off the one going down the creek, and started chasing it back toward the other one. The empty crate was lying on the bank, the beaver in passing it evidently regarded it as a place of protection, and ran back into it. Ranger Gallegos then closed the sliding door, and carried it up stream to the other one and released it. In the meantime, the other one had worked up stream, and finding a hole in the bank, stuck his head into it and remained there. He was prodded up with a stick, but would not move, seemingly considering himself out of sight and protected.

The plan of management provides for the restocking of all streams of sufficient size in which beavers do not at present exist, and along which there is sufficient aspen or other food for them. There are only five such streams on the Forest. It is hoped to continue the work until a small breeding nucleus is placed in each of these streams, with the coöperation of the state if it can be secured. Judging from the results of three transplanted in Itasca Park, Minnesota, in 1900, and the rate at which they are thought to be increasing there, a large nucleus will not be necessary; but if sufficient coöperation is extended by the state in the way of furnishing a professional trapper to assist, four to six per stream would be better. This would serve to bring up production in the shortest period of time and serve to show what improvement in stream conditions can be expected from the ranchmen's point of view. A clear demonstration of the stabilizing effect upon the stream flow of beaver activities will be of value in fixing their place.

It is planned as an experiment to try to catch them with a woven-wire crate or net placed with the opening over the entrance to the house or to the entrance of the den in case of bank beaver, first closing up the other one of the two entrances. Then, by poking them up in the den, it is proposed to force them out and into the net. This should work during the daytime, since from what information there is available they remain in the dens or houses during the day, and are not easily disturbed. This has been talked over with one or two of the local trappers who think it feasible. If it fails, the wire-corral method will be used.

Also in undertaking any future work, it is planned to catch the beaver earlier in the season, preferably about the first of August, since high water is then over, making it easier to trap them, and allowing the

planted specimens more time to become located, build a house and store food before winter sets in.

The estimate made of the beavers in 1918 showed 12,000 in the streams within the vicinity of the Forest. While this may have been a little high at the time, it is believed to be conservative at the present time. Anything approaching an accurate census, however, has not yet been made. On streams, like Saguache Creek, which are subject to flooding and washing out of dams, not nearly all of the beavers construct dams. They often simply burrow into the bank and make dens without them. This fall numerous runways and cuttings of willows were observed along the creek, and dens without dams. The observations of local trappers and also of the state trapper agree with the information given by the Biological Survey that they average about four kits to the litter. From information obtained from Mr. J. D. Figgins of the Colorado Museum of Natural History, they have a litter each year, and the young ones remain with the old until they are two years old, or until the third litter is born. This would indicate that there are two litters in most dams. There is one point, however, which has not been cleared up. That is, whether the secondary dams are also regularly inhabited. Some claim that the two-year-olds occupy them when pushed out by the parents, but there is a difference of opinion as to this. With the gathering of a little more information as to their habits, it is hoped to make a more accurate census, but it is going to require time and close observation.

Likewise, there is very little information about natural losses and rate of increase. Estimates of the numbers in Long Branch Creek showed 50 beavers in 1908 and 3,000 in 1918, indicating an average yearly increase for the period of about 50 per cent. This, however, is based only on estimates. In order to be conservative, an annual increase of 25 per cent has been assumed until such time as more accurate information can be obtained. It is evident at any rate that they increase rapidly, judging by the new dams constructed each year.

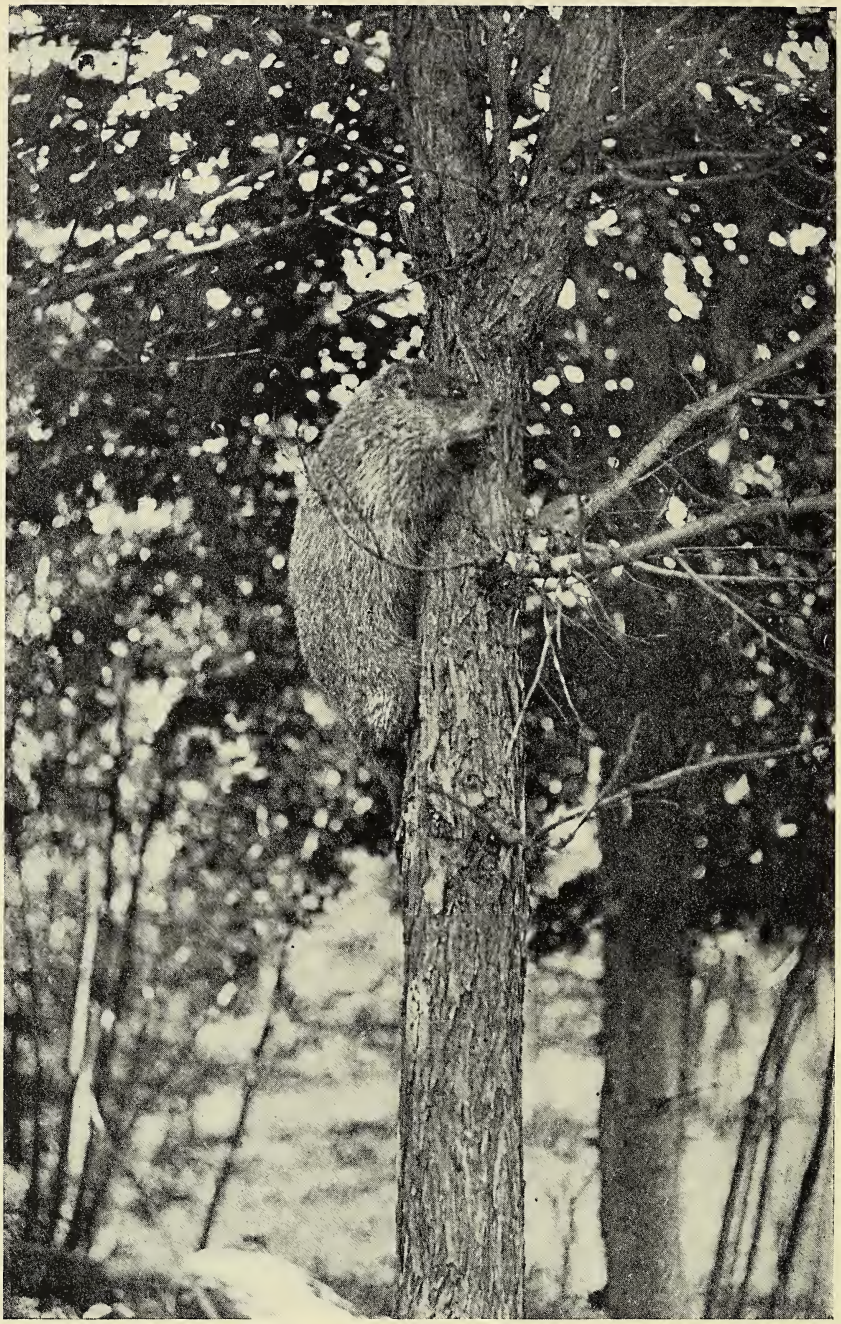
I have traveled for days on end through the Forests of Wyoming over lands of first quality for fur animal production. A trapper at Valley Wyoming wrote me not long ago that he had out 200 miles of trap lines and he was not doing so well because the martens were scarce. That while there was lots of feed such as rabbits and squirrels in the region where he was trapping, the martens were not there and he thought they had just been trapped out. In fact, he believed the only hope for the marten is a closed season.

The Forest Service has an agreement with the Wyoming State Game Department which provides that all applications for trapping permits will be submitted to the forest supervisor concerned for consideration and recommendation before action is taken. Now it is true that the present state game warden, dealing in generalities, has expressed himself in favor of the destruction of all fur animals because he claims they prey upon game birds. Upon the other hand, the Wyoming law is so worded that the issuance of trapping permits is discretionary and there are some eight forest supervisors supported by observant rangers conversant with all animal range types in the state. Surely an active force of such size in a fertile field should be able to bring forth sufficient evidence to convince one man of the unsoundness of his position. Game birds were plentiful in the Shoshone National Forest when I first knew it fifteen years ago at a time when fur animals were much more numerous than they are now. Food and seasonable weather have far more to do with the prevalence of game birds, say the grouse family, than the presence of fur animals. Continued cold wet weather when the chicks are just hatched plays havoc with game birds just as a scarcity of food in any section may cause the birds to migrate. The weasel, I have no doubt, is most destructive to all bird life; however he is not much sought by the average fur trapper.

My idea would be the preparation of maps of the Forests for the state game warden designating certain watersheds where trapping of stated animals should be prohibited for a given period of years. There must be sound reason for this recommendation, set forth in detail. Such elimination of the taking of fur animals to let them reach a normal production should not in any way interfere with trapping wolves, coyotes and cats.

Certainly the subject of fur production offers an excellent field for action with obligations for initiative upon the proprietors of the land best suited to such purposes.

Washington, D. C.



A TREE-CLIMBING WOODCHUCK
Marmota monax preblorum
(St. John: Tree-Climbing Woodchuck.)

A TREE-CLIMBING WOODCHUCK

By Harold St. John

[*Plate 15*]

In June, 1920, the New England Botanical Club held its annual spring field trip in the upper Connecticut Valley. To Mr. Richard J. Eaton and myself was assigned a territory including Quechee Gulf in eastern Vermont. On the afternoon of the 12th, we had clambered along the base of the cliffs on the north side of this deep gorge, and at the lower end crossed the Ottauquechee River and started up the hill-side to the south of the river into the town of Hartland. In the midst of an open pasture I stooped to dig a prostrate plant, and as I rose I saw that Eaton, who had walked ahead towards a clump of trees, had stopped and was beckoning to me. He had scared a woodchuck from the open ground and it had run to the trees and climbed six feet up a tree eight inches in diameter. While it hung there watching us, I drew out my camera and took a snapshot at a distance of thirty feet. Still the woodchuck clung to the tree trunk, so I quietly approached to within six feet and snapped another picture, which is here reproduced. My companion then joined me and finally stepped up and stroked the animal on the back. This was to confirm what we saw, that the animal had fur, not quills on its back, and to make perfectly sure that it was a woodchuck, not a porcupine. We were close enough to see that it was a female. On being stroked, she hitched around to the opposite side of the trunk. After hanging there a minute, she turned, dropped to the ground and scuttled off, disappearing in a thicket.

Whenever I have related this incident, it has met nothing but incredulity. After my long acquaintance with the woodchuck in southern New England, I am afraid that I too would have been inclined to doubt the accuracy of anyone telling me that woodchucks climbed trees. Yet Eaton and I certainly saw the thing done, and I am lucky enough to have a good photograph to substantiate my statement. It seems desirable to put this bit of field observation on record.

State College of Washington, Pullman, Wash.

ON THREE NEW MAMMALS FROM JAPAN

By Nagamichi Kuroda, M.A.S.M.

The following mammals from Japan seem to be undescribed. They are preserved in my own collection. All measurements are in millimeters.

Sciuropterus russicus orii subsp. nov.

Characters.—Resembles *S. russicus russicus* Tiedemann of Siberia and Russia, but the greatest length of skull and mandible longer, the breadth of interorbital constriction narrower, the length of upper and lower tooth-rows shorter. It differs from *S. russicus athene* Thomas of Sakhalin, by the much paler coloration of body, by the greatest length of skull longer, by the zygomatic breadth wider, by the palatal foramina longer, and by the upper tooth-row shorter. It essentially differs from *S. momonga momonga* (Temminck) and *S. momonga amygdali* Thomas of Japan.

Description.—Upper parts a uniform pale silvery gray, with a clay cast; the region of crown and nape tinged with a deep tone of the color; lores and cheeks paler and almost white; a narrow blackish eye-ring; under parts and

Dimensions of the type and other specimens

LOCALITY	DATE	HEAD AND BODY	TAIL	HIND FOOT	EAR	SEX	MEASURED BY
Kushiro, Hokkaidō.......	1909	150	121	34	20	♂	H. Orii
Kushiro, Hokkaidō.......	1909	147	118	35	19.5	♂	H. Orii
Uyenai, Iburi, Hokkaidō .	February, 1915	153	105	33.5	21.5	♂	H. Orii
Uyenai, Iburi, Hokkaidō .	February, 1915	146	97.5	32.5	20	♂	H. Orii
Uyenai, Iburi, Hokkaidō .	February, 1915	148	112	32	20.5	♂	H. Orii
Uyenai, Iburi, Hokkaidō .	March 13, 1920	163	117	34	19.5	♀	H. Orii

Comparative measurements of skulls of three forms of S. russicus

SUBSPECIES	GREATEST LENGTH	BASILAR LENGTH	ZYGOMATIC BREADTH	POSTORBITAL CONSTRICTION	INTERORBITAL CONSTRICTION	ROSTRAL BREADTH AT FRONT OF NASAL	NASAL	DIASTEMA	PALATILAR LENGTH	PALATAL FORAMINA	LENGTH OF BULLÆ	MANDIBLE	UPPER TOOTH-ROW	LOWER TOOTH-ROW	MEASURED BY
*S. r. orii**...	39.5	30.5	24	9.0	7.5	6.5	13.0	8.0	17.0	5.5	10.5	24.5	6.5	6.5	Kuroda
S. r. athene..	37.0	28.0	22	—	7.0	—	—	—	16.2	4.8	10.1	—	7.2	—	Thomas
S. r. russicus	36.2–36.8	—	24±–24.2	9–9.4	8.4–9	6.4–6.8	12.8–13.2	8.2	—	—	—	23.2	7.2–7.4	7.2	Miller

* Type specimen.

inner surface of limbs pure white with ashy bases to the hairs; tail distinctly buffy on marginal parts and blackish on the median area; upper surface of hand dusky, and that of hind foot grayish white; hairy part of soles grayish white; lower surface of toes naked.

The type specimen was obtained by Mr. H. Orii at Uyenai, Prov. Iburi in Hokkaidō, March 13, 1920, and was presented by him to my collection. The subspecific name is given in honor of the collector.

Mustela rixosa namiyei subsp. nov.

Mustela nivalis Linnæus, subsp., Kuroda, Annot. Zool. Japon., Vol. IX, p. 610 (1920).

Characters.—Resembles *M. rixosa pygmœa* (J. A. Allen) of Siberia, but the length of head and body longer and the tail decidedly longer. It differs from *M. rixosa rixosa* (Bangs) from Arctic America, by the smaller body. It also differs from *M. rixosa eskimo* (Stone), by the paler coloration of body, and by the somewhat longer tail.

Dimensions of the type and other specimens

SUBSPECIES	LOCALITY	HEAD AND BODY	TAIL	HIND FOOT	EAR	SEX	DATE	MEASURED BY
*M. r. namiyei**	Awomori N. Hondō	190	—	18.5	11	?	—	Kuroda
M. r. namiyei	Awomori N. Hondō	190	30	20	—	♀?	November 9, 1907	Namiye
M. r. namiyei	Near Sapporo, Hokkaidō	200	26	20.5	11	?	December 20, 1899	Kuroda
M. r. pygmœa	Siberia	158	16	21	—	♀	October 2, 1900	J. A. Allen
M. r. pygmœa	Siberia	184	19	23	—	♂	January, 1902	J. A. Allen
M. r. pygmœa	Siberia	166	13	19	—	♀	January, 1902	J. A. Allen
M. r. eskimo ..	Alaska	204, 230	28, 31	20	—	2♂s	—	Stone
M. r. eskimo ..	Alaska	178–184	22–25	16–23	—	3♀s	—	Stone

* Type specimen.

Comparative measurements of skulls of namiyei and pygmœa

SUBSPECIES	GREATEST LENGTH	BASILAR LENGTH	ZYGOMATIC BREADTH	INTERORBITAL CONSTRICTION	ROSTRAL BREADTH OVER CANINES	OCCIPITAL DEPTH	MASTOID BREADTH	LENGTH OF BULLÆ	MANDIBLE	UPPER TOOTH-ROW	LOWER TOOTH-ROW	MEASURED BY
M. r. namiyei	31.5	30	17	7.5	5.5	9	14.5	11	16	8.5	10.5	Kuroda
M. r. pygmœa......	28.5	—	13.3	—	—	—	12.5	—	—	—	—	J. A. Allen

Description.—Upper parts a uniform pale cinnamon color, instead of dark reddish brown of *M. rixosa pygmœa*, including the outer side of fore and hind limbs to the base of toes; lower parts, inside of the limbs, fore feet, and apical half of hind feet pure white, the lower parts unmixed with any other mottling; edge of upper lip and lower half of cheeks white; ears very small, cinnamon haired like the upper parts; tail short.

The type specimen was obtained at Awomori, N. Hondō, Japan, and was presented to me by Mr. K. Wada. Date unknown.

The late Mr. M. Namiye examined a specimen of this animal obtained by Mr. E. Kinashi at Awomori, November 9, 1907, wrote a brief description of it, and named it after Mr. Kinashi ("Shokuniku Shōjū Rui Chōsa Hōkoku," Jan., 1911). This report was sent to the Department of Agriculture and Commerce, but unfortunately remains unpublished. For that reason I publish the more detailed description of this interesting animal under the above subspecific name in memory of Mr. Namiye.

The weasel is distributed from northern Hondō to Hokkaidō. Some weasels were obtained on Sakhalin, Kurile Islands, and on the Korean Peninsula, but I have not yet examined their skins.

It is a very interesting fact that the Japanese form belongs to the *rixosa* group of Arctic America rather than to the Old World *nivalis* (=*vulgaris*) group. J. A. Allen also mentioned the fact when he described his *pygmœa* from Siberia.

Pteropus daitoensis sp. nov.

Pteropus dasymallus (nec Temminck), Kuroda, Annot. Zool. Japon., vol. IX, p. 599, 1920 (part.).

Description.—Fur of back long and spreading, especially on mantle and hind neck, where wooly in structure; ears short, half visible from the outside of the fur; sides of crown, face, cheeks, chin, lower half of the dorsal parts and flanks, as well as clothed parts of tibia and forearm, seal-brown; this hair tipped with grayish or buffy on center of lower back; center of crown, occiput, whole hind neck, mantle, breast and center of abdomen very pale whitish buff, faintly tinged with yellowish; crown somewhat sprinkled with seal-brown hairs; this pale color on center of crown passing through the forehead and reaching to the base of nose; a large golden buff patch on both sides of neck and continued in middle of fore neck; the pale area on center of abdomen sprinkled with seal-brown longer hairs; the bases of fur in all pale areas with the same color as the apical parts.

Measurements

	♂ AD. (TYPE)	♂ AD.
Forearm	130.0 (about)	127.5
Pollex, total length	60.0	54.0
2nd digit, metacarpal	67.0	64.0
2nd digit, 1st phalanx	17.5	18.0
2nd digit, 2nd-3rd phalanx	16.5	16.0
3rd digit, metacarpal	93.5	88.5
3rd digit, 1st phalanx	70.0	66.5
3rd digit, 2nd phalanx	96.0	85.5
4th digit, metacarpal	92.0	88.0
4th digit, 1st phalanx	59.5	52.5
4th digit, 2nd phalanx	59.5	52.5
5th digit, metacarpal	96.0	93.0
5th digit, 1st phalanx	45.5	41.5
5th digit, 2nd phalanx	47.5	41.0
Ear	22.5	19+x
Ear, greatest width flattened	16.5	—
Front of eye to tip of muzzle	25.0	—
Tibia	—	62.5
Foot with claw	43.5	40.5+x
Calcar	15.5	15.0
Skull, greatest length	—	62.5
Skull, basilar length	—	57.5
Skull, zygomatic breadth	—	34.5
Skull, width of brain-case at zygomata	23.0	23.5
Skull, postorbital constriction	7.5	7.0
Skull, interorbital constriction	10.0	10.0
Skull, orbital constriction	—	12.0
Mandible, length	48.5	48.5
Upper tooth-row	23.5	24.0
Lower tooth-row	27.0	27.0

The type specimen was obtained on Kita-Daitōjima, Daitō Islands, one of the Southeastern Loo-Choo group. The above two specimens were presented to me by Mr. S. Uchida.

This species is closely related to *Pteropus dasymallus* Temminck of South Loo-Choo Islands, but the coloration is wholly different.

Fukuyoshi Cho, Akasaka, Tokyo, Japan.

A NEW PINNIPED FROM THE UPPER PLIOCENE OF CALIFORNIA

By Remington Kellogg

During the month of December, 1920, the writer, in company with Mr. E. L. Furlong, spent several days examining California collections of marine mammals. This work was undertaken under the auspices of the Carnegie Institution of Washington and under the direction of Dr. John C. Merriam. Although search for pinniped remains was not the principal object of this trip, a number of fossils were located, among which the most important were contained in the collection of Stanford University. These specimens were generously placed at the writer's disposal for study and description by Dr. David Starr Jordan and by Prof. J. P. Smith.

The material figured and described in the present paper was discovered by Mr. Robert Anderson in a Pliocene formation of southern California and belongs to the Geological Department of Stanford University. Dr. Joseph Grinnell, director of the Museum of Vertebrate Zoology, and Mr. Gerrit S. Miller, Jr., curator of mammals of the United States National Museum, have greatly facilitated the writer's studies on fossil Pinnipedia by the loan of skeletons of the living pinnipeds for comparison. These fossil bones have been compared with a number of the living pinnipeds besides *Eumetopias*, notably with *Zalophus, Arctocephalus, Callorhinus, Odobenus, Monachus,* and *Mirounga,* as well as with other fossil genera, the descriptions of which are now in press. In this paper comparisons are made with *Eumetopias jubata* (No. 8821, Mus. Vert. Zool.), *Zalophus californicus* (No. 16296, U. S. Nat. Mus.), *Odobenus divergens* (No. 21331, U. S. Nat. Mus.), and *Mirounga angustirostris* (No. 15270, U. S. Nat. Mus.). The illustrations for this paper were made by Mrs. Frieda Abernathy.

Fossil remains of the family Otariidæ are very little known. There are several extinct otarids on record, but many of these are based on very scanty and dubious material. This statement is especially true of teeth of doubtful reference found in France. In North America no evidence for Tertiary otarids on the Atlantic Coast has been recorded. True, in 1905, described *Pontolis magnus* from beds belonging to the Empire formation at Coos Bay, Oregon, based on the occipital and basicranial region of the skull. No limb bones were described by True[1]

[1] True, F. W., Smithsonian Misc. Coll. (Quart. Issue), vol. 48, pt. 1, no. 1577, p. 48, Washington, D. C., 1905; Prof. Paper No. 59, U. S. Geol. Surv., Dept. Interior, pp. 144–147, pls. 21–23, Washington, D. C., 1909.

and thus far no limb bones have been recorded from the Empire formation. Until such are found, it will be impossible to show the relationships of *Pontolis* to other otarids known only from limb bones that have recently been discovered in the Tertiary deposits of the Pacific Coast. *Desmatophoca oregonensis*[2] from Yaquina Bay, Oregon, has much the same status, as nothing more than the skull and the lower jaw have been recorded. Both of these specimens belong to considerably older formations than the Paso Robles. No fossil walrus remains have thus far been described from the Pacific Coast of North America, and their apparent absence from Tertiary deposits of this coast has not been satisfactorily explained.

The fossil pinniped discussed in this paper has many characters in common with the genera *Eumetopias* and *Odobenus*. The humerus resembles *Odobenus* in the thinness of the external margin above the outer condyle, and the extent to which the inner condyle is produced. The presence of a large articular surface for the trochlea on the head of the radius and a well-defined tubercle are additional points in common with the walrus. The large size of the ulna, especially the distal end, shows a further approach to the odobenid type. The position of the articular surfaces on the styloid process and the extent of the radial facet on the distal end of the ulna resembles *Eumetopias* more closely than *Odobenus*. The general appearance of the humerus, with the exception of the points previously mentioned, agrees with the otarid type.

The possession of characters in common with both the Otariidæ and the Odobenidæ introduces a serious problem in the allocation of this fossil to its proper family. Moreover, since nothing is known concerning the skeleton of *Pontolis*, any determination must be regarded as more or less provisional. In consequence of these facts the writer tentatively refers this specimen to the family Otariidæ.

Pliopedia pacifica gen. et sp. nov.

Type.—No. C. 537, Stanford University. Species based upon a number of incomplete bones including a humerus, radius, ulna, three metacarpals, two metatarsals, and three phalanges.

Locality.—In uncharted section of Township 29 South, Range 13 East (San Luis Quadrangle), on summit of hill one mile southeast of Santa Margarita,

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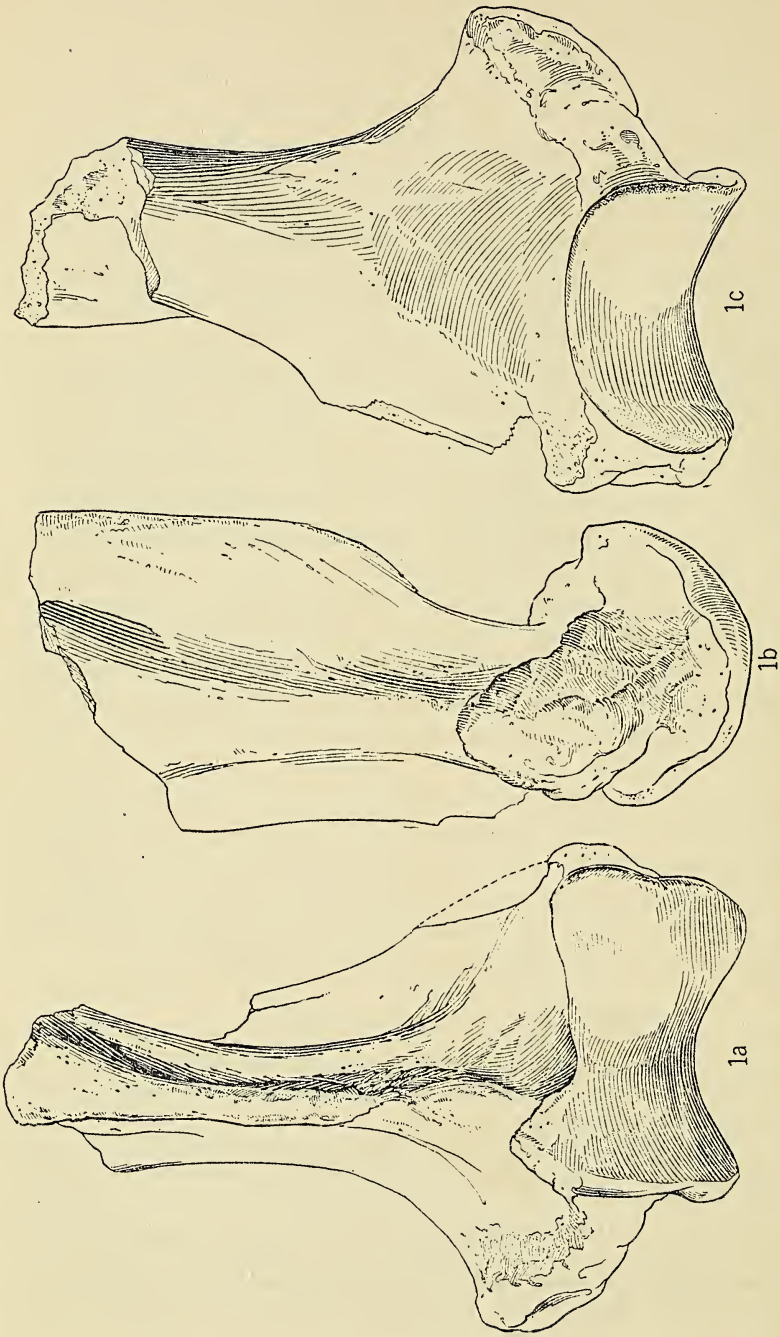
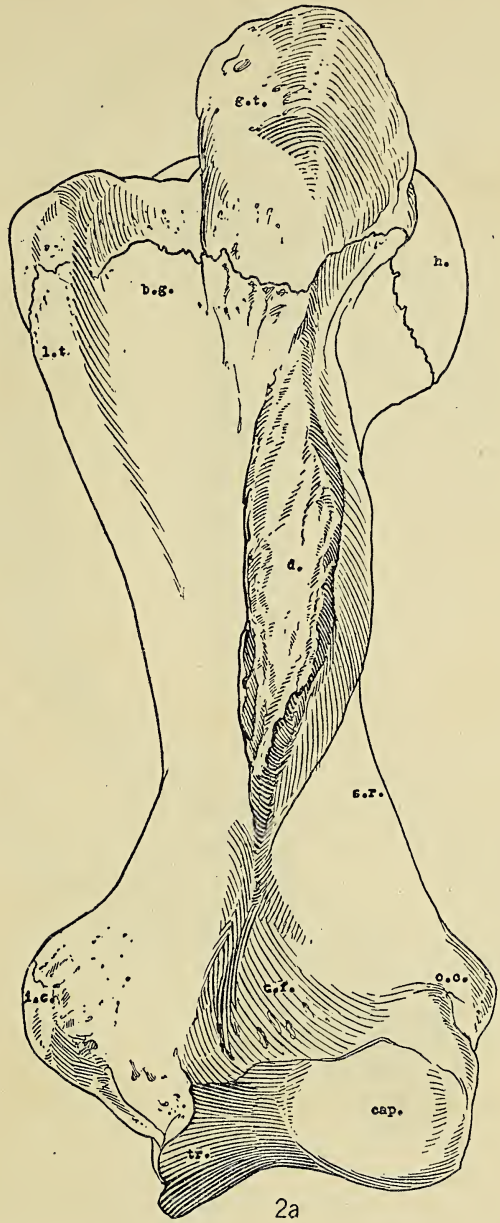
[2] Condon, T., Univ. Oregon Bull., suppl. to vol. 3, no. 3, pp. 5–14, pls. 1–2, text figs. 1–3, Eugene, Oreg., 1906; Wortman, J. L., Science, n.s., vol. 24, no. 603, pp. 89–92, 1906; Hay, O. P., Proc. U. S. Nat. Mus., vol. 49, no. 2113, p. 383, Washington, D. C., 1915.



LEFT HUMERUS OF *Pliopedia pacifica* × ½ No. C. 537, STANFORD UNIVERSITY
Santa Margarita, California: fig. 1a, anterior view; fig. 1b, internal view; fig. 1c, posterior view.



2a

LEFT HUMERUS OF *Eumetopias jubata* × ½ No. 8821, MUS. VERT. ZOOL.

Año Nuevo Island, California: fig. 2a, anterior view. *b.g.* bicipital groove; *cap.* capitellum; *c.f.* coronoid fossa; *d.* deltoid process; *g.t.* greater tuberosity; *h.* head; *i.c.* inner condyle; *l.t.* lesser tuberosity; *o.c.* outer condyle; *s.r.* supinator ridge; *t.r.* inner trochlea.

LEFT HUMERUS OF *Eumetopias jubata* × ½, No. 8821, MUS. VERT. ZOOL.

Año Nuevo Island, California: fig. 2b, internal view

LEFT HUMERUS OF *Trichecodon koninckii* × ½ (AFTER VAN BENEDEN, 1878, ATLAS, pl. 7, FIG. 1)

Antwerp basin, Belgium; fig. 3a, anterior view


3b

LEFT HUMERUS OF *Trichecodon koninckii* × ½ (AFTER VAN BENEDEN, 1878, ATLAS, pl. 7, FIG. 2)

Antwerp basin, Belgium; fig. 3b, internal view

between Trout Creek and Yerba Buena Creek, San Luis Obispo County, California. The hill is probably the south one of the two 1,200 ft. knobs on the sheet.

Horizon.—The specimens were discovered by Robert Anderson in March, 1909, in a formation of gravel and sand overlying typical Santa Margarita beds. These beds are considered to belong to the Paso Robles formation of the Upper Pliocene.

The left humerus of this form differs very considerably from that of *Alachtherium cretsii*[3] and also from that of *Alachtherium antwerpiensis*[4] and to a less extent from that of *Trichecodon koninckii*[5] as figured by Van Beneden. Its most striking general characteristic is the antero-posterior compression of the distal end and the lateral compression of the shaft in the deltoid region.

When seen in front (fig. 1a), the shaft appears considerably narrowed at the middle, arcuate in outline externally, and flaring out suddenly internally at the distal end. The external border no doubt arose below the overhanging posterior hook of the head of the humerus, as in *Eumetopias jubata* (fig. 2a), for its superior margin is so directed while it widens out distally as the supinator ridge. The deltoid ridge is prominently developed and forms the sharp anterior edge of the shaft. The anterior margin of the deltoid crest folds over the external border of ridge in both *Eumetopias* and *Zalophus*, while in *Odobenus* the folding over is on the internal side. In *Mirounga* the deltoid ridge is low and the crest is uniformly rounded; this approximates more closely the type of deltoid ridge exhibited by this fossil humerus. However, the deltoid ridge itself curves or folds over the internal side to a slight degree in this fossil though not to such a marked extent as in *Odobenus*.

When viewed from the internal side (fig. 1b), the deltoid ridge is seen to curve prominently upward, though the antero-posterior diameter of the shaft in the deltoid region is not conspicuously wider than a lower trochlear portion, as is the condition in both *Eumetopias jubata* (fig. 2b) and *Trichecodon koninckii* (fig. 3b). This humerus resembles somewhat that of the common sea lion of the Pacific Coast, but is slightly smaller throughout than the humerus of the old male used for comparison, and a little broader at the distal end. The supinator crest is a little more flaring and sharp edged than in *Eumetopias jubata*, the trochlea is relatively wider, and the internal condyle is more produced. The external margin of the shaft is very thin and sharp edged in both *Odobenus* and this fossil. This margin is rounded in *Eumetopias* and *Zalophus* though in *Arctocephalus australis* it is slightly compressed and sharp edged.

The coronoid fossa is apparently quite deep in comparison with those of *Eumetopias jubata*, *Zalophus californicus*, or *Odobenus divergens*, though the exposed surface of the humerus in this area has suffered slightly from erosion. This fossa is bordered internally by a broad rounded ridge extending up towards the lower end of the obliquely placed deltoid crest. This ridge is considerably reduced in *Odobenus divergens* and is more prominent in *Zalophus californicus*

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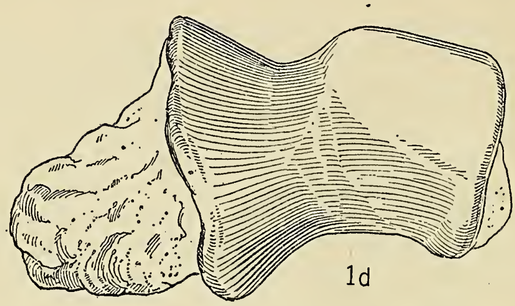
[3] Van Beneden, P. J., Ann. Mus. Roy. Hist. Nat. Belgique, Atlas, vol. 1, pl. 3, figs. 1–2; pl. 4, fig. 1, Bruxelles, 1878.

[4] Hasse, G., Bull. Soc. Belge de Geol., de Paleon., et d'Hydrol., vol. 23, Memoires, pl. 5, figs. 1–4; pl. 6, fig. 1, Bruxelles, 1910.

[5] Van Beneden, P. J., *op. cit.*, Atlas, pl. 7, figs. 1–2.

than in *Eumetopias jubata.* The inferior face of the shaft (fig. 1c) is somewhat flattened, being slightly twisted on the long axis from the external to the internal side. The surface of the shaft is missing in the area where the olecranon fossa should occur, extending inward as far as the inferior margin of the inner condyle.

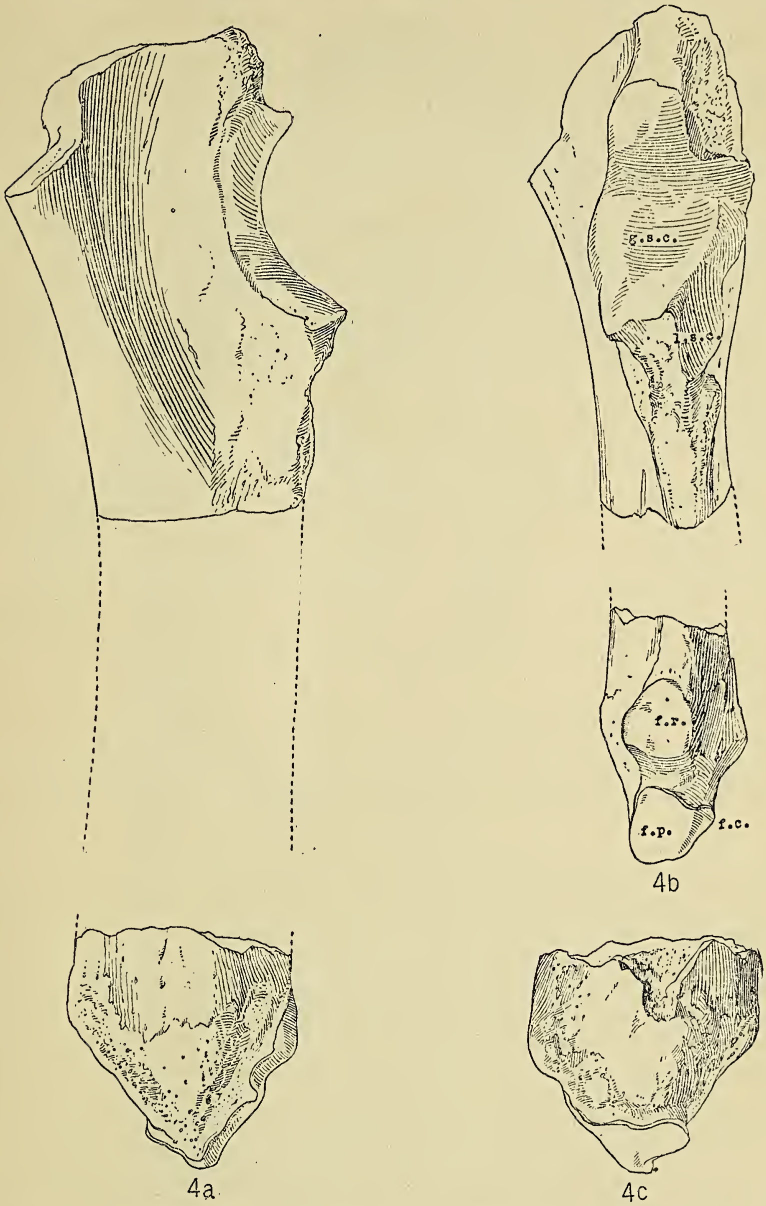


Left Humerus of *Pliopedia pacifica* × ½, No. C. 537, Stanford University Santa Margarita, California: fig. 1d, distal view

The trochlear surface (fig. 1d) for articulation with the bones of the forearm is divided into an outer and less convex capitellum articulating with the radius, and a trochlea articulating almost entirely with the ulna, though to some extent with the inside of the proximal facet of the radius. From an inferior view (fig. 1c.), the trochlea is observed to be convex from above downward and concave from side to side. It is limited internally, externally, and proximally by a sharp crest.

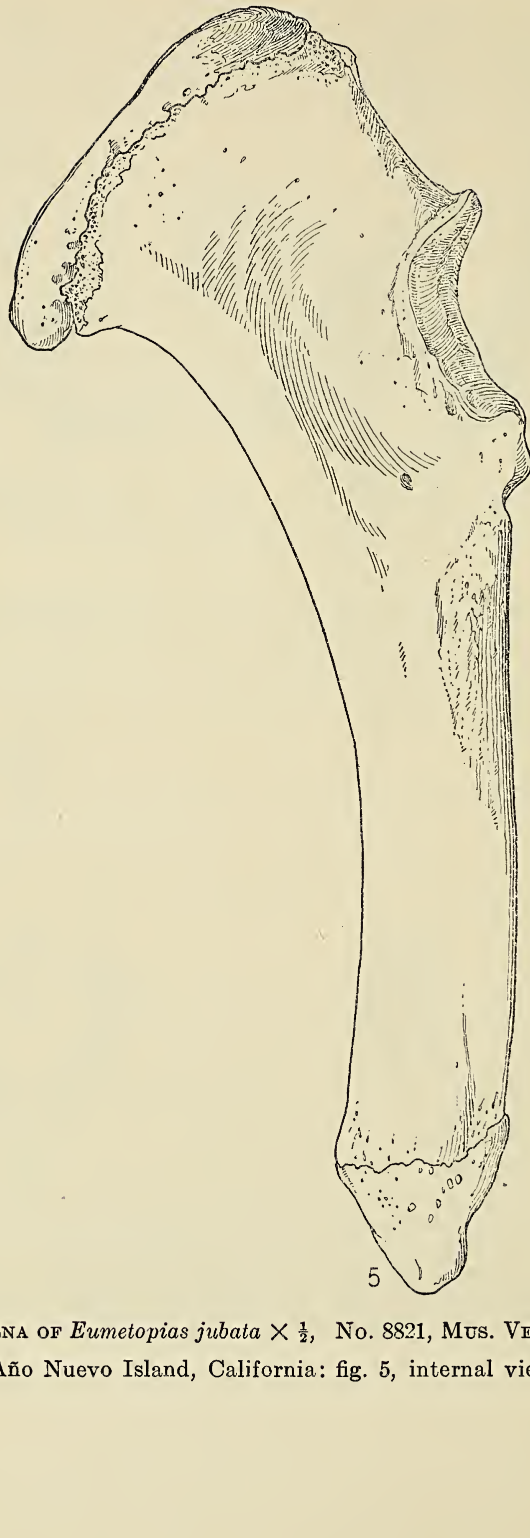
The inner condyle is a triangular tuberosity projecting internally and slightly backward; its anterior surface is a continuation of the internal surface of the shaft and is bounded medially by the coronoid fossa. The outer condyle is much less prominent than the inner. The external surface is a continuation downward of the supinator ridge. It is convex from above downward, forming a shallow crescentic concavity between its inferior margin and the rounded edge of the capitellum.

In its general form the ulna (fig. 4a) was undoubtedly much like that of *Eumetopias jubata* (fig. 5), or that of *Odobenus divergens,* but with the distal end much stouter and broader. It is very much larger than the radius, as in other pinnipeds. The olecranon process and the proximal end of the ulna beyond the semicircular greater sigmoid cavity are missing. This articular surface on the anterior face of the ulna for the trochlea of the humerus is characterised by an evenly concave curve, wider above than below; its proximo-distal diameter (fig. 4b) is proportionately greater than in *Eumetopias jubata.* Immediately below the greater sigmoid cavity and on the external face there is a shallowly concave articular surface which receives the head of the radius. Below this lesser sigmoid cavity is a small rounded tuberosity which articulates with the tubercle on the postero-internal margin of the shaft of the radius (fig. 6c). No trace of this tuberosity is observed on the ulna of *Odobenus divergens* or of *Zalophus*



LEFT ULNA OF *Pliopedia pacifica* × ½, NO. C. 537, STANFORD UNIVERSITY

Santa Margarita, California: fig. 4a, internal view; fig. 4b, anterior view; fig. 4c, external view distal fragment. *f.c.* facet for cuneiform; *f.p.* facet for pisiform; *f.r.* facet for radius; *g.s.c.* greater sigmoid cavity; *l.s.c.* lesser sigmoid cavity.



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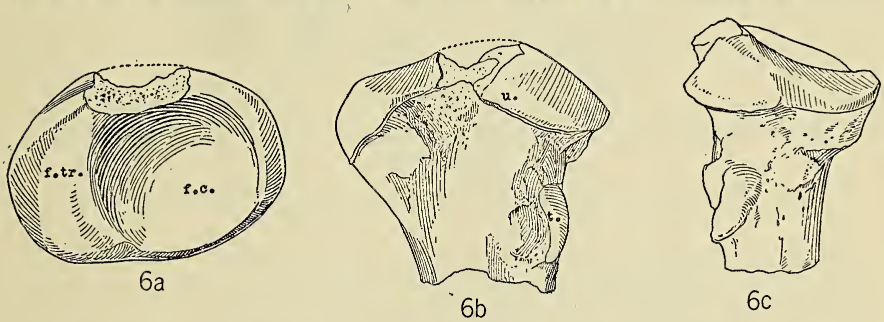
LEFT ULNA OF *Eumetopias jubata* × ½, No. 8821, MUS. VERT. ZOOL.
Año Nuevo Island, California: fig. 5, internal view

californicus, though a very rudimentary one is found on that of *Eumetopias jubata.* The coronoid process is broken off.

The shaft of the ulna is sub-triangular in section. In the area of the greater sigmoid cavity the shaft is convex on the external face and deeply concave on the internal; the posterior margin of the shaft is twisted towards the internal side. The external face of the ulna below the greater sigmoid cavity in both *Odobenus* and *Eumetopias* is concave.

The distal end is considerably enlarged in contrast with that of *Eumetopias jubata.* The articular facets are not sharply marked off from the roughened shaft. The articular surface on the anterior border for articulation with the radius (fig. 4b) is separated from a similar surface for the pisiform by a shallow groove. This facet for the radius is slightly convex; it faces forward and slopes slightly to the internal margin. The styloid process (fig. 4c) has two articular



LEFT RADIUS OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY

Santa Margarita, California: fig. 6a, proximal view; fig. 6b, posterior view; fig. 6c, internal view. *f.c.* facet for capitellum of humerus; *f.tr.* facet for inner trochlea of humerus; *t.* tubercle; *u.* ulnar facet.

surfaces, one for the pisiform and the other for the cuneiform, the contact being oblique in both cases. Both of these articular surfaces are slightly concave.

The proximal end of the radius (fig. 6a) is suboval in shape, as in *Odobenus divergens.* The facet for the capitellum is of considerable extent and strongly concave; it slopes downward from the ulnar to the anterior margin of the head. This facet is continuous internally with the convex articular surface for the trochlea of the humerus. The trochlear facet slopes downward to the internal margin of the head of the radius. It is also continuous posteriorly with the ulnar facet. In general form the head of the radius approaches very closely that of *Odobenus divergens,* the ulnar facet (fig. 6b) being comparatively flat, permitting of but a limited degree of rotation with the lesser sigmoid cavity of the ulna. It differs from both *Eumetopias jubata* and *Zalophus californicus* in the extent of the facet for the trochlea, which is considerably reduced in these two forms.

The neck is clearly defined on all sides. The tubercle (fig. 6c) is located on the postero-internal margin of the shaft, its superior margin terminating 18 mm. below the inferior margin of the ulnar facet. Adjacent to it there is a low rugose tuberosity. The tubercle is subtriangular in outline; its greater diameter is

20 mm. and it terminates below in a bluntly pointed apex. A tubercle similar in shape is present in *Zalophus californicus*, though only a scar marks its presence on the radius of *Eumetopias jubata*. In *Odobenus divergens* the tubercle and tuberosity of the fossil are represented by a pair of flattened adjoining articular surfaces.

The structure of the carpus is unknown and it is hoped that future geological work in this region will result in the accumulation of additional material. The metacarpals are relatively slender and slightly enlarged at their articulations.

7a 7b

RIGHT METACARPAL I OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY

Santa Margarita, California: fig. 7a, dorsal view; fig. 7b, proximal view

The first metacarpal of the right fore limb (fig. 7a) differs from the others in its larger size and in the shape and direction of its proximal articular surface. Its proximal surface (fig. 7b) for articulation with the trapezium is convex from the dorsal to the palmar border and concave transversely. On the ulnar face is a concave articular surface for the corresponding facet on the head of the second. The shaft is sub-triangular in outline; immediately below the proximal facet and

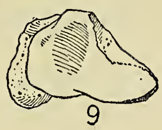
8a 8b 8c

LEFT METACARPAL III ? OF *Pliopedia pacifica* × ½, No. C. 537, STANFORD UNIVERSITY

Santa Margarita, California: fig. 8a, radial view; fig. 8b, ulnar view; fig. 8c, dorsal view.

on the dorsal face there is present a shallow depression. On the radial face of the head are two smooth surfaces; one is somewhat flattened and slopes obliquely to the palmar face; the other is slightly concave and faces proximally. The palmar face of the shaft on the proximal end is strongly concave.

The determination of the remaining four bones is very difficult, owing to the want of a complete series of the bones of either the metacarpus or the metatarsus. Moreover, the similarity of these elements to one another introduces another element of doubt when one attempts by comparison with living otarids to allocate these bones definitely. In consequence of these difficulties the following determinations of these bones must be regarded as more or less provisional.

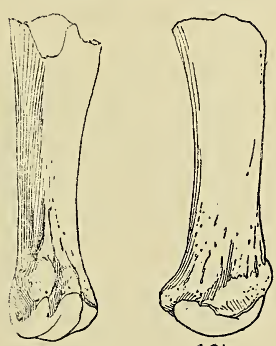


9

Right Metatarsal II ? of *Pliopedia pacifica* × ½, No. C. 537, Stanford University

Santa Margarita, California: fig. 9, proximal view

The best preserved of these four bones is assumed to be the third metacarpal on the left side. Its proximal surface is strongly concave from before backward. This surface is continuous with a shallowly concave facet (fig. 8a) on the radial face. On the ulnar surface of the base (fig. 8b) near the dorsal border is a concave facet for articulation with the adjoining metacarpal. This third metacarpal is somewhat expanded at the base and to a less extent at the head (fig. 8c); the shaft curves inward to a greater degree than is normal in *Eumetopias*.



10a 10b

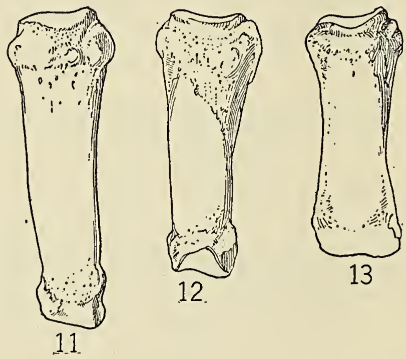
Right Metacarpal IV ? of *Pliopedia pacifica* × ½, No. C. 537, Stanford University

Santa Margarita, California: fig. 10a, plantar view; fig. 10b, tibial view

Among these four is the base of what is considered to be the second metatarsal. Its proximal end (fig. 9) is triangular in outline; the articular surface slopes from the plantar to the dorsal border and is concave from side to side. On the tibial margin is a rounded process for the internal cuneiform, and more proximally and nearer the plantar border is a second facet for the same element.

The base of the next bone to be considered is missing, and there is nothing distinctive about the shaft (fig. 10a) to indicate its true position, though possibly it may be the fourth metacarpal. The shaft (fig. 10b) is somewhat curved from the base to the head.

The fourth bone to be discussed consists of a fragment of the base of what appears to be the fifth metatarsal but this lacks the epiphysis. It has not been figured and with the exception of the flattened triangular outline of the shaft and the long dorso-plantar diameter, there is nothing particularly distinctive about it.



Phalanges of *Pliopedia pacifica* × ½, No. C. 537, Stanford University

Santa Margarita, California: fig. 11, dorsal view of second phalanx; fig. 12, dorsal view of third phalanx; fig. 13, dorsal view of fourth phalanx.

The phalanges of the forefoot were apparently very similar to those of *Eumetopias jubata*, judging from the three which were collected. There is nothing remarkable or unusual about these bones, for they agree in all their principal features with those of *Eumetopias* and differ only in minor details of the facets and in the curvature of the shafts. The proximal facet on the base of the second phalanx is concave from side to side; the curvature of the shaft (fig. 11) is toward the radial side, and the facet on the head is convex from above downward. It is considerably longer than the third or fourth phalanx. The third phalanx (fig. 12) is much stouter and shorter than the second and is essentially the same as the corresponding phalanx of *Eumetopias jubata*. The fourth phalanx (fig. 13) is slightly shorter and relative stouter than the third, and the head is equal in width to the base.

Bureau of Biological Survey, Washington, D. C.

A REVIEW OF SOME RECENT WORK ON THE MAMMALIAN REPRODUCTIVE CYCLE

By George W. Corner

Workers in the physiology of reproduction, usually undertaking investigations to serve their practical needs as gynecologists or animal breeders, have found themselves under the necessity of understanding the reproductive cycles of some of the common domestic mammals, and have thus been forced to study natural history in a field but little cultivated by the faunal naturalists. In the end, however, gain may be had in both directions, for it can hardly be doubted that important evolutionary trends underlie the present extraordinary diversity of the reproductive phenomena of mammals. It will not be necessary to point out here extended illustrations of this diversity; we may briefly recall that among the ungulates alone we have such phenomena as the annual rutting of deer, in some species accompanied by violent oestrous manifestations in both sexes; in ewes an annual season of several repeated "heats;" in domesticated sows and cows a perennial cycle of about twenty-one days interval. In the laboratory rodents there appear to be perennial cycles of diverse lengths, with outward manifestations so slight that they may evade even the practised watcher; while in the catarrhine apes and man we have a perennial cycle averaging four weeks, with what might be called a dispersed oestrus, and with the additional phenomenon of menstruation. Internally the same apparent diversity reigns; mammals differ as much in their uteri as in their brains, and the comparative ovarian histologist might almost duplicate some feats of the paleontologist who names a species from a single tooth or vertebra, for it requires but little skill to distinguish all the common domestic mammals by glancing at sections of their ovaries. These histological differences concern not only mere details of architecture and of size, but also the duration of growth of the corpus luteum, the rate and type of atresia of the Graafian follicles, and the amount of interstitial tissue.

Attempts to untangle the problem have led, during recent decades, to the development of two general ideas about which current work is centering. It seems probable, first, that in all mammals the ripening of ova is a regularly periodic function accompanied by characteristic changes primarily in the ovaries and secondarily in the whole reproductive tract; and second, that these changes are continued after ovulation

in such a way that the uterus is prepared to receive and nourish the embryos which may result from the ovulation if mating occurs. It is likely that all the phenomena of the female reproductive cycle can in the end be related to these two ideas.

With regard to the first point an important step was gained by Stockard and Papanicolaou (1917) when by extending certain old and almost unnoticed observations they showed that the oestrus of the guinea-pig, outwardly so inconspicuous, is actually marked by a series of characteristic changes in the vaginal wall, so that microscopic examination of a smear of the vaginal fluid enables the observer to predict the occurrence of ovulation with accuracy. At intervals of about fifteen days there is first a desquamation of epithelial cells and then the passage of white blood cells in great numbers through the vaginal wall; if the animal is killed on the day of these changes its ovaries are found to contain ripe follicles with mature ova, and the uterine epithelium is in a characteristic state interpreted by Stockard and Papanicolaou as indicating active degeneration.

Long and Evans (1920, 1921) whose preliminary notes are about to be extended in a comprehensive monograph, have attained such accuracy with similar studies on the albino rat that they can predict the time of ovulation within one hour, and in their hands the method is already serving as a tool for the investigation of many problems of the oestrous cycle. In the white rat ovulation is very frequent (every four to six days), the interval being actually less than the time required for the passage and implantation of the fertilized ova. It will be seen that this frequency would inevitably lead to superfoetation, were it not for a special mechanism discovered by Long and Evans, namely that the act of copulation itself postpones the next ovulation for a sufficient length of time to protect the mother from a second crop of ova, until the pregnancy itself can work the usual further postponement. The mechanism by which this end is attained seems to be a reflex from the genital canal, for the mere insertion of a glass rod into the cervix uteri is as effective as a normal copulation.

Allen (1921) has worked out a similar cycle in the albino mouse; and we may now look forward to the application of such studies to some of the supposedly special cases among rodents, such as the rabbit, in which it is said that ovulation cannot be completed without copulation. No applications of this method to mammals of other orders have as yet been reported, although there is good reason to expect interesting results in this direction. However there have been several contri-

butions sharpening our knowledge of the relation between ovulation and oestrus in animals showing marked outward signs of heat, as for instance those of Longley (1912) on the cat, Lewis (1911) and Corner and Amsbaugh (1917) on the sow, and Küpfer (1920) on the cow. In all these animals oestrus is promptly followed by the development of corpora lutea in the ruptured Graafian follicles.

The second general idea outlined above has slowly grown out of the suggestion of Prenant and Born that the corpus luteum is a gland of internal secretion, serving to produce changes in the uterus and ovary. Later workers, including Fraenkel, L. Loeb, Ancel and Bouin, Hill and O'Donoghue, and others, have developed the hypothesis by assuming that the changes effected by the corpus luteum are aimed at facilitating the implantation of the embryos. The best experimental attack on the problem was made in 1907 by Leo Loeb, who found that (in the guinea-pig) when newly-formed corpora lutea are present in the ovaries, and then only, the uterine mucosa is in a specially responsive state, so that the presence of the ova, or even of an artificial foreign body, leads to the production of a decidual or placenta-like change of the uterus. In its simplest form this beautiful experiment, now several times confirmed by others, requires only that one select an animal about one week after an unfertilized ovulation, and traumatize the uterine mucosa with a needle. Four or five days later the stimulated areas are marked by the presence of swellings histologically resembling decidual tissue. Preliminary removal of the ovaries (or, according to Loeb, of the corpora lutea alone) prevents the formation of the deciduomata.

The present writer has attempted, by way of testing the foregoing considerations, to study the whole ovarian and uterine cycle in one species, and to make the supposed utility of the uterine changes for implantation of the embryos something more than a matter of hypothesis, by actually correlating the state of the uterus at every stage with the progress of the ova and embryos. For this purpose the domestic sow was chosen, because it appears to be the only mammal whose earliest embryology and mode of implantation are as yet sufficiently known and accessible to re-study which at the same time exhibits uncomplicated and outspoken oestrous phenomena.

It has been found, in brief, that the external manifestations of oestrus, which recur at intervals of about twenty-one days, are associated with a regular ovarian cycle. A day or two before the onset of oestrus a group of follicles is prepared for ovulation; they rupture

during the oestrous period, and are succeeded by corpora lutea, which reach their full development in one week, and remain in active state until the fifteenth day after ovulation, when they suddenly degenerate to make way for a new group of follicles. If the ova are not fertilized they pass into the uterus and degenerate there about the seventh or eighth day; but if fertilized they become attached to the uterine mucosa between the tenth and fifteenth days, at the very time when the corpora lutea are at their height. (In this case, of course, the corpora lutea do not degenerate, but persist throughout pregnancy.) There is also a parallel series of changes in the uterus. At oestrus the uterine mucosa is in a state like that described in the rodents by Stockard and Papaincolaou and by Long and Evans; but during the following week it undergoes marked growth changes, and during the second week (the time of implantation) still further histological modifications take place which seem clearly adapted to aid first in transporting and then in attaching the embryos. These alterations go on, however, whether or not the ova are fertilized; but if no embryos are formed, then when the corpora lutea degenerate the uterine mucosa also reverts to its original condition, and by the simultaneous occurrence of epithelial degeneration and proliferation is brought back to the oestrous stage.

Long and Evans (1921) find that in the albino rat there are characteristic changes of the vaginal mucosa during the first weeks of pregnancy. Under the conception which we have been outlining, similar changes should occur after an unfertilized ovulation, but it appears that their full development is aborted by the briefness of the cycle in this species. However, as Long and Evans have discovered, if the return of oestrus be postponed by the insertion of a glass rod into the cervix uteri, as described above, then the vagina shows changes in every way similar to those of pregnancy.

It will be apparent from the foregoing review that this branch of investigation has now reached a stage of exploration and of comparison, and that there is a pressing necessity for careful study of the reproductive habits of all accessible mammals. From the medical standpoint an especial interest attaches to the mechanism of reproduction in the primates, and it is here that the greatest service can be rendered by those who deal with wild animals at large and in captivity, by gathering together enough information to give a basis for experimental work. We have seen that this work must be founded upon specific knowledge of life-processes; at present we have little more than hearsay and travellers' tales about the reproductive cycle of the monkeys and apes.

For instance, though it is at last definitely known that the old-world monkeys undergo menstrual phenomena very similar to those of the human species, yet with regard to the new-world forms all one can learn after somewhat persistent querying is that no one has seen a menstruating platyrrhine monkey; whether these American monkeys have an annual breeding season, or bear young at all seasons of the year, does not appear in books of natural history. These questions will serve to show the importance of a field of inquiry in natural history, as yet almost unexplored, in which are to be gained results of immediate practical utility. And finally, as we hinted at the beginning, it is not beyond hope that when common laws are understood through all the diversity of form and function, light may be thrown upon some of the wider questions of mammalian evolution.

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TWO NEW RODENTS FROM OREGON AND NEVADA

By E. A. Goldman

Golden-mantled chipmunks representing the various geographic races of *Callospermophilus lateralis* (Say) occur throughout most of the higher mountains of the western United States, and outlying forms reach Canadian and Mexican territory. A readily distinguished subspecies appears to be isolated on the upper slopes of the Charleston Mountains, southern Nevada. These mountains are completely surrounded by Lower Sonoran deserts which are doubtless effective barriers limiting the distribution of this species and responsible for the differentiation noted.

This chipmunk and a heretofore undetected form of one of the rarer kangaroo rats, *Perodipus microps*, are characterized as follows:

Callospermophilus lateralis certus subsp. nov.

NEVADA GOLDEN-MANTLED CHIPMUNK

Type from Charleston Peak (north base), Charleston Mountains, Nevada. No. 208891, ♂ adult (teeth slightly worn), U. S. National Museum (Biological Survey Collection), collected by Luther J. Goldman, June 29, 1915. Original number 2270.

Distribution.—Known only from the Charleston Mountains in southern Nevada.

General characters.—Distinguished by pale general coloration in combination with dark russet under side of tail; most closely allied to *C. l. trepidus*, but ground color paler, the under side of tail however, of a dark, rich russet, instead of ochraceous-buff or ochraceous-tawny tone. Similar in color to *C. bernardinus* but paler and cranial characters distinctive.

Color (summer molt nearly complete).—Head, neck and shoulders between tawny and ochraceous-tawny, varying in intensity but tending to become paler on sides of neck and shoulders, more or less mixed with grizzled gray or presenting a patched appearance during the molt; median dorsal area grizzled grayish brown becoming darker on rump; inner black stripes broad and distinct; flanks light grayish; underparts whitish or dull grayish, the dark basal color of hairs showing through; throat and chin ochraceous-buffy in some specimens; feet dull whitish, or pale buffy; tail above mixed black and ochraceous-buff changing to grizzled grayish brown near base, below rich russet interrupted by a narrow black lateral line and ochraceous-buffy edging.

Skull.—Closely resembling that of *C. l. trepidus*, but slightly smaller and lighter, with narrower ascending branches of premaxillæ, and rather narrow basioccipital. Compared with *C. l. chrysodeirus* and *C. bernardinus* the nasals are more wedge-shaped, narrower posteriorly and nearly conterminous with premaxillæ (usually extending posteriorly well beyond premaxillæ in *chrysodeirus* and *bernardinus*).

Measurements (type).—Total length, 251; tail vertebræ, 76; hind foot, 38. An adult male topotype: 256, 80, 39. Two adult female topotypes respectively: 247–240; 79–70; 39–37. *Skull* (type): Greatest length, 42.8; zygomatic breadth, 25.9; interorbital breadth, 9.1; length of nasals, 13.5; upper molariform toothrow, 8.2.

Remarks.—In the rich russet color of the under side of the tail *C. l. certus* departs from its nearer geographic neighbors, *C. l. trepidus*, *C. l. chrysodeirus* and *C. bernardinus*. In this character it agrees closely with *C. l. castanurus*, but differs widely from the latter form in much paler general coloration, and in cranial details, especially the larger audital bullæ. Specimens from Arc Dome, Reese River (near head), Monitor Mountains, and Toyabe Mountains, Nevada are somewhat intermediate in characters between *C. l. certus* and *C. l. trepidus*, but may be assigned to the latter form.

Specimens examined.—Four, all from the type locality.

Perodipus microps preblei subsp. nov.

PREBLE'S KANGAROO RAT

Type from Narrows, Malheur Lake, Harney County, Oregon. No. 79340, ♀ adult, U. S. National Museum (Biological Survey Collection), collected by E. A. Preble, July 23, 1896. Original number 1201.

Distribution.—Plains regions of southeastern Oregon and northwestern Nevada.

General characters.—Closely allied to *P. m. microps* and *P. m. levipes* but color darker than is typical of either, and cranial characters distinctive. Differing from *P. m. levipes* in slightly smaller size.

Color (type).—Upperparts near pinkish cinnamon (Ridgway, 1912), finely and rather inconspicuously lined with black; underparts, and extent and arrangement of white and black markings about as usual in the group.

Skull.—Similar in general to those of *P. m. microps* and *P. m. levipes*, but decidedly smaller than that of the latter and differing from both as follows: Mastoid and audital bullæ smaller, the mastoids less inflated along line of contact with parietals and supraoccipital resulting in a more flattened condition of this portion of cranium; supraoccipital decidedly broader, less depressed above, and more widely separating mastoids; maxillary arches very narrow, with angle slightly developed as usual in the species.

Measurements (type).—Total length, 263; tail vertebræ, 154; hind foot, 41. An adult male topotype, 269, 158, 41. *Skull*: Length (median line), 33.5; mastoidal breadth, 22.4; breadth across maxillary arches, 19.2; least width of supraoccipital (upper surface near posterior border of interparietal), 2.5; length of nasals, 11.6; upper molariform toothrow, 4.2.

Remarks.—Specimens referred to *P. m. levipes* from various localities in California, Nevada and Utah are darker than the typical form and indicate intergradation with the geographic race here described.

Specimens examined.—Total number, 11, from localities as follows:

OREGON: Narrows (type locality), 7; Summer Lake, 1; Tumtum Lake, 2.

NEVADA: Granite Creek, Humboldt County, 1.

Biological Survey, Washington, D. C.

GENERAL NOTES

A FOX ASSOCIATING WITH MOUNTAIN SHEEP ON THE KENAI PENINSULA, ALASKA

In the fall of 1912, Morris L. Parrish and Wilson Potter, both well known sportsmen in Philadelphia, made a hunting trip to the Kenai Peninsula, Alaska. In a sumptious folio volume Mr. Parrish privately published his diary of this trip and illustrated it with two hundred and nine photographs. The title is: "Hunting on The Kenai Peninsula A Daily Diary Illustrated with Some Photographs By Morris L. Parrish, Philadelphia, Pa.; 1913. Privately Printed." This is an extremely interesting record of the trip and the game. Since but few copies were issued and therefore the observations recorded will never be easily available to naturalists, it seems worth while to record in the Journal of Mammalogy an unusual sight witnessed by Mr. Parrish and his guide, H. E. Revell, who was indicated as the "Colonel."

In the mountains about the divide between Tustamena Lake and the Kenai River, Mr. Parrish on the date mentioned killed a ram. The following quotation follows this event: "September 18, 1912. . . . . We went right on thinking there might be some more sheep in a gulch further down, and here we saw what the Colonel said was a most remarkable and un-heard-of sight. Three rams were on the side of a hill, walking along in single file, and a cross fox was walking with them, he jumping up and biting their faces in play, and they butting him gently along in front. When they lay down he lay down too, and they were evidently travelling together, and the best of friends. We watched them for fully 15 minutes through the glasses at about 300 yards. There was another ridge, some 200 yards further on, and we crawled along this, but when we reached it the rams had disappeared. We saw the fox some distance off, but could not find the sheep again. . . . ."—Charles Sheldon, *Washington, D. C.*

A WOLVERINE IN A TREE

In connection with the recent notes by Dr. George Bird Grinnell on the ability of the wolverine to climb trees I would like to call attention to a photograph of one in a tree which was published in the National Geographic Magazine, vol. 29, May, 1908, p. 353. The picture was taken in October, 1907, in Big Horn County, Wyoming, by Alan D. Wilson, who says: "The photo is I think almost unique for they are not only rare, but generally prefer to go over the rimrock than tree when chased."—N. A. Wood, *Museum of Zoology, University of Michigan, Ann Arbor, Mich.*

A MONGOOSE IN KENTUCKY

On December 20, 1920, a mammal received for identification by the United States National Museum, during the absence of Mr. Gerrit S. Miller, Jr., curator of mammals, was referred to me for determination. The specimen consisted of a cased skin, with the feet, tail, and anterior portion of the snout attached, including most of the maxillary and mandibular teeth. It was an adult mongoose, *Herpestes griseus* E. Geoffroy. The animal had been trapped by Mr. Thomas May, November 18, 1920, in a field just on the edge of the village of Midway,

Woodford County, Kentucky. Mr. May noticed that something had been running under a haystack, and, thinking it might be a mink, he set a trap under the stack and caught the mongoose,—an animal entirely strange to him and to other people of the vicinity. No record of how the mongoose reached the region can be traced.

This animal, *Herpestes griseus*, a native of India, is the same species which has been introduced into Cuba, Porto Rico, and several other places, for the destruction of noxious rodents, but it has become a serious pest on account of its destruction of poultry and birds. The capture of a single animal in the United States should not in itself unnecessarily alarm us, but it should stimulate us to be doubly on our guard. In spite of laws, ably administered and rigidly enforced, against importation or shipment of the mongoose in this country there is always a possibility that the animal might become established. Should such ever be the case it would spell the doom of all ground-nesting birds throughout a great part of the United States. Everybody interested in conservation of native wild-life should be able to recognize the mongoose and should report any occurrence of the animal in the country at once to the U. S. Biological Survey. The animal is really quite unlike any native North American species and is easily identified. It is a carnivore about the size of the mink and of similar proportions. The tail, however is rather longer than that of the mink, and tends to taper toward the tip. The animal is furred rather scantily, particularly ventrally, with a coarse, hispid hair. Its general tone of color is yellowish gray, distinctly flecked or grizzled with brownish black and whitish. This color effect is produced by an underfur of clay color intermixed with the longer guard hairs each one of which is banded alternately with fuscous-black and buffy white, the fuscous-black bands being the longer.—Hartley H. T. Jackson, *U. S. Biological Survey, Washington, D. C.*

PRIBILOF FUR SEAL ON THE OREGON COAST

On February 1, 1921, an immature male Pribilof fur seal (*Callorhinus alascanus* Jordan and Clark) in a badly emaciated condition came ashore on the ocean beach about a mile north of the bar at Netarts Bay, Tillamook County, Oregon. When first seen by a local resident the seal was high up on the dry sand, above normal high tide, and was "quite active." About two hours later, when Mr. Clarence Edner of Netarts went to look for it, he found it lying dead in the wet sand just above the breakers. Mr. Edner thinks that after the animal was first seen it made an attempt to return to the sea but died before reaching the water.

So far as I am aware, this is the only authentic record in recent years of the occurrence of the Pribilof fur seal on the Oregon coast.—Stanley G. Jewett, *Portland, Oregon.*

ELEPHANT SEALS OFF THE COAST OF CALIFORNIA

In the May number of the Journal of Mammalogy, page 112, there appeared an article by A. W. Anthony recording the appearance of elephant seals off the southwest coast of California. Several years ago Capt. Chas. Davis captured several young elephant seals on Guadalupe Island and brought them, alive, to

Venice, California, where they were exhibited in a tank of water for a year or two. The tank was on a pier extending out into the ocean.

A year or two ago a heavy storm demolished that portion of the pier where the seals were exhibited and they escaped into the ocean. It is quite probable that these animals, or some of them at least, are still living in the waters off southwestern California. No elephant seals have been heard of in this vicinity for many years. The nearest rookery is Guadalupe Island and it seems more natural to believe that the specimens recently reported are escaped animals rather than ones that have left the herd at Guadalupe and wandered north.—John Rowley, *Los Angeles Museum, Los Angeles, California.*

MUSKRATS IN CENTRAL EUROPE

In 1906 Princess Colloredo-Mannsfeld imported four pairs of muskrats (*Fiber zibethicus*) from America and turned them loose in Dobrisch, an estate southwest of Prague, Bohemia. These animals subsequently increased in such numbers that at present they have spread all over Bohemia, into Upper and Lower Austria and Moravia and also into Bavaria and Saxony, following the water-courses.

The muskrats have shown themselves to be very injurious, as they construct their burrows in the dams and embankments of the rivers and ponds, and thus, by undermining the banks they endanger the whole system of waterways, subjecting the surrounding fields to the danger of floods.

Very strict regulations have been issued, therefore, in all the countries invaded by the muskrat, to curtail its further spread, and it is generally forbidden under heavy fines to maintain the animals, breed them, or turn them loose. All persons, directly or indirectly interested, are required to report every appearance of muskrats to the authorities. Owing to his secretive habits of life, the muskrat often succeeds in remaining unnoticed for a considerable period in his new haunts.

The muskrat is inclined to be nocturnal, but in districts where he feels himself unnoticed he is to be seen during the day also. In general it has been observed that during overcast weather and dark nights the rats do not appear for days at a time, and rarely swim about when it is windy. The muskrat builds his summer-dwelling in the high banks or dams of water courses and ponds. This consists of a burrow from which a carefully concealed exit leads to the bank, often 10 to 15 feet away; other runways lead under the water level and to the bottom of the water. Piles of earth which have been removed from the ponds are also used.

The animals established in Europe breed twice or three times a year and produce 6 or 8 young at a time. Thus an annual family of 18 to 24 young may be expected which sufficiently explains the phenomenal spreading of the species.

In winter the muskrats often abandon their burrows and build so called "winter-castles" in shallow places in the ponds. These consist of heaps of bitten off reeds, rushes or sedges, more or less mixed with mud. They have a diameter of 3 to 6 feet, project 2 to 3 feet above water level, and have no visible exits. These quarters contain a dry sleeping-place above water level and, connected with it, a burrow extending into the water.

As to the damage caused by the muskrat to fish and game the opinions vary greatly, some saying it is inappreciable, others that it is very great. As a matter of fact our animal feeds chiefly upon plants; he is even said to enter fields of grain and cut down the stalks. If plants are sufficiently plentiful he sticks to them, but if not he robs the nests of wild water-birds, even hen-yards and store houses. At any rate it is not surprising that when he has chosen a well stocked fish-pond for his headquarters he should take to catching and eating fish. In Bohemia, the centre of activity of the muskrat in Europe, there is a very extensive fisheries industry, based upon fish which are maintained in more or less artificial ponds.

I shall refrain from discussing the natural history, the general appearance or other peculiarities of the introduced muskrat, as those of his American ancestor are well known. I only intended showing how some imported animals will thrive, if adapted to their new surroundings.—Theodor G. Ahrens, *Berlin, Germany.*

MALFORMED HIND FOOT OF THE COMMON HOUSE MOUSE (MUS MUSCULUS)

I recently captured a house mouse possessing a hind foot with six toes, instead of the usual five. The toe representing the thumb is a trifle undersize, while the superfluous member is overgrown, and protrudes awkwardly at a sharp angle from the foot. The foot itself and the remaining toes are in every way normal. I trapped this animal near Guelph on March 29, 1921, in the heart of a low, wet, and dense swamp of cedars, balsam, aspen, willow, etc. The ground in many places was carpeted with moss a half-inch or more in thickness—just such a place as one might be certain of taking the red-backed vole if it were farther north. I was somewhat surprised to find a house mouse here, having never before trapped this domestic pest under conditions of this kind, and so far removed from buildings. Doubtless it indulges occasionally in protracted wanderings, bringing up finally in some barn or house.—J. Dewey Soper, *Guelph, Ontario.*

NOTES ON NAPÆOZAPUS

This rare mouse has long been a subject of thought to me, and in early August of 1920 I made a trip of some hundreds of miles for the the express purpose of seeking it, but failed. What was my surprise, then, to find two in my traps on the morning of August 23, at Canoe Lake, Algonquin Park, Ontario. Subsequent nights yielded one, three and one, and then a blank, as though the supply were exhausted. Two of these fell to the traps of Stuart Thompson, of Toronto, but all the success was in a very limited area. I had been expecting to find them in deep, dark evergreens, near water, but these were captured in a small clump of alder and willow on the bank of a beaver stream. Careful examination had showed what seemed to be a runway on the dead leaves covering the ground, and the trap set on that runway yielded a mouse every night until the last, when trap and all vanished. A mink, perhaps. Further search revealed a little pile of the scales of alder fruit, and a trap set at that place by Mr. Thompson caught a mouse the next night, and near it was an alder cone partly eaten. Whether the animal is partially arboreal—totally unexpected, if true—could only be

guessed at, as we had only the one piece of evidence, but numerous traps spread out in other places than this alder thicket with one exception, yielded nothing. This was across the stream, perhaps 80 feet away, where the beaver had worn a path through the sod in climbing up a steep bank. About 5 feet up the bare path ceased, and under the overhanging sod were two mouse holes. One was right in the center of the path and there was no possible chance but that the beaver would spring any trap set there before the mouse got into it, but the other hole was at one side, and there I made a little shelf with my knife and set the trap which caught a *Napæozapus* the next morning. Further trapping at this point was fruitless, but the holes looked good, even when we left. In view of this little insight into the habits of this species I should feel rather confident of trapping it in alder thickets along beaver streams when the fruit of the alders was ready to eat.

The beautiful colors of these mice faded rapidly, and when the last one was caught Mr. F. W. Fraser kindly gave me a painting of the fresh specimen in accurate colors. An interesting feature of this new acquaintance is the instant identification by means of the size, color, and tail. Often have I tried to study a *hudsonius* into an *insignis* in vain; but when *insignis* was taken, there was never a doubt, nor any need to turn to a description. I should say that *insignis* weighs 50 to 100 per cent more than *hudsonius;* the colors, similar in the museum specimen, are much more vivid, and the tail is so much heavier at the base, as to be an immediate mark of recognition.—W. E. Saunders, *London, Ontario.*

AN INQUISITIVE PORCUPINE

Just at dusk on the evening of June 12, 1919, I caught sight of an adult porcupine (*Erethizon dorsatum*) coming along a road through heavy timber in the Penokee Range, 8 miles southwest of Mellen, Wisconsin. I remained standing still. He approached in his slow, deliberate way, absolutely unaware of my presence. The air was calm, there being no detectable breeze. At a distance of about 20 feet from me the animal stopped, looked up and around in different directions, and sniffed the air. He evidently was either rather suspicious or detected the odor of food. But he remained there only a second or two, then continued to within 15 feet, again stopped, looked directly at me, and sniffed for nearly 2 minutes, his nose in the air toward me all the while. Meantime I withstood scores of biting mosquitoes and remained perfectly silent. After "sizing up" the situation, so to speak, the porcupine changed his course an angle of 45 degrees and came directly toward me. I remained silent until he began gnawing my leather putees, when I thought it time to protest, so I made a slight movement, and "porkie" scampered away and hid among the logs and brush by the roadside.—Hartley H. T. Jackson, *U. S. Biological Survey, Washington, D. C.*

GRAYSQUIRRELS AND NUTS

At the National Zoological Park in Washington on January 23 last, I saw a graysquirrel burying a nut. It is commonly supposed that this instinct is active only in autumn. Can any one give observations to show that it is operative the

year round when food is sufficiently plentiful?—ERNEST THOMPSON SETON, *Greenwich, Conn.*

FORMER RANGE OF MOUNTAIN SHEEP IN NORTHERN CALIFORNIA

Recent references to the occurrence of mountain sheep in northern California appear to be restricted to Mount Shasta and the adjacent Sheep Rock, a locality only a few miles north of the great mountain. The present Sheep Rock however is very different from the Sheep Rock of the early gold-seekers. The latter, as shown by George Gibbs in his Journal and accompanying map of the McKee Expedition of 1851, was situated on the *west* side of Scott Mountains, a range to the west of Shasta Valley, which it separates from Scott Valley. The Sheep Rock of 1851 is a prominent landmark as seen from Scott Valley, and is now known both locally and on the maps of the Geological Survey as Skookum Rock. It was inhabited by Sheep in Gibbs' time—how much later we do not know.

The Shaste Indians tell me that sheep formerly occurred on Goose Nest Mountain and on Bogus Mountain north of Goose Nest Mountain, and also in the Siskiyous, but just how far west they ranged in the Siskiyous I have not been able to ascertain. In 1888 I saw in a hardware store in Portland, Oregon, a mounted ram of large size killed in the Siskiyous by the proprietor of the store.

It would be interesting to know whether the big horn of these elevated mountains—Mount Shasta, Scott Mountains, Goose Nest Mountain, Bogus Mountain, and the Siskiyous—was the same species as the one formerly inhabiting the Modok Lava Beds in the northeastern corner of California.—C. HART MERRIAM, *Washington, D. C.*

TWO MAMMALS NEW FOR OHIO

On February 2, 1921, Mr. Franklin Grothaus, a young farmer of my parish, brought me a fine ♂ of *Mustela cicognani.* For years the state of Ohio has been searched for this species, but the fact that the closest point to Ohio where it had been taken was in Pennsylvania, about 600 miles from here, and in Michigan, about 500 miles to the north, made it unlikely that it ever would be found. It is with pleasure that I record this new species for the state of Ohio. Measurements: length, 268 mm.; tail, 67 mm.; h. f., 30 mm. The specimen is now in my collection.

The other species new for Ohio, one that has been diligently looked for, as all the old records turned out to be something else, is *Microtus ochrogaster,* of which I have 3 specimens up to date, all taken by Mr. Hy. Ruese, a farmer of my parish living in Shelby County, Ohio, 2½ miles east of New Bremen. The first one, a ♀ taken February 15, 1921, measured: length, 131 mm.; tail, 21 mm.; h. f., 17.5 mm.; mammæ 6, foetuses 4. The second one, taken February 22, 1921, a ♂, measured: length, 126 mm.; tail, 20 mm.; h. f., 17 mm. Four weeks of trapping did not yield any results till on April 5 another ♀ was caught, measuring 130 mm. in length; tail, 19 mm.; h. f., 17 mm.; mammæ 6, foetuses 0. Thus it seems to be that the species is very rare here and probably reaches its easternmost point of distribution.—W. F. HENNINGER, *New Bremen, Ohio.*

WILD LIFE AND THE MOTOR CAR

On November 7, 1920, I motored from Austin to San Antonio, Texas, some 82 miles. On the road, evidently killed by motors travelling by night, were 4 cottontails, 2 dogs, 2 rats, 1 opossum, and 1 very large skunk. It is remarkable that the cottontail commonly suffers more than any other game animal from motor cars.—Ernest Thompson Seton, *Greenwich, Conn.*

RECENT LITERATURE

Winge, Herluf. A Review of the Interrelationships of the Cetacea. Smithsonian Misc. Coll., vol. 72, no. 8, 97 pp., 1921. [Translated by Gerrit S. Miller, Jr., from Vidensk. Medd. fra Dansk naturh. Foren., Copenhagen, vol. 70, p. 59–152, 1918.]

The paper here translated is one of a series of studies by Doctor Winge on the orders of mammals. It commences with a brief statement of the supposed derivation of the group and an account of the more obvious ways in which the structure of cetaceans departs from that of land mammals as a result of a wholly aquatic existence. Following this, the major groups of the order are taken up in sequence, their chief characters are enumerated, and an attempt is made to trace a possible line of evolution for them.

The earliest known cetaceans appear in the Eocene, already equipped for living wholly in the water. They include several genera of zeuglodonts, and while some of these—*Basilosaurus* (*"Zeuglodon"*)—had already reached the height of their development, there still survived at least one member of the group so primitive that the dentition is nearly unchanged from that of one of the creodonts (*Hyænodon*). This primitive genus—*Protocetus* from the Eocene of Egypt—is accepted by Winge as in the direct ancestory of the group which he calls Zeuglodontidæ, though others including its discoverer are not convinced that these are true cetaceans.

At the conclusion of the first half of the paper (p. 45) the author sums up his views. He recognizes six families of Cetacea, all of which however are not of equivalent value, namely: (1) the "Zeuglodontidæ" (=Basilosauridæ) to include these Eocene genera which he considers are unquestionably primitive cetaceans, and "must have made their appearance somewhere within the territory occupied by the hyænodonts, and probably in the oldest part of the territory." (2) The Balænidæ, in which he includes all whalebone whales, and believes them to be derived "from the more primitive genera" of zeuglodonts, a view at variance with that of Abel, who believes the Miocene *Patriocetus* offers a connecting link between toothed and baleen species. Gregory also suggests the comparatively recent origin of the group. (3) The Squalodontidæ, whose members he would have spring "from the most primitive, tooth-bearing balænids," a view for which it is difficult to see any satisfactory basis. Both True and Abel agree in placing the Oligocene *Agorophius* (for which Abel makes a separate family) as a near ancestor of the squalodonts. (4) The Platanistidæ, considered "the descendants of the primitive squalodonts." Here are included the four living genera *Steno-*

delphis, *Lipotes*, *Inia*, and *Platanista*, long-beaked river-dolphins. The combination of characters exhibited by at least three of these genera has made their classification a matter of much controversy. While at variance with the latest views of Abel and of True, there is much to commend the close association of the other genera named with *Platanista* instead of making a special family for them. True's final conclusion, however, was that *Stenodelphis* might best be included as a member of the Delphinidæ. (5) The Delphinidæ, which Winge believes to have branched off early in the Tertiary, from "primitive platanistids." The family is a somewhat heterogeneous assemblage, and its final constitution is still unsettled. (6) The Physeteridæ, including the ziphioids as a subfamily, which are supposed by Winge to have "originated from the most primitive delphinids" during early Tertiary time, but as no members of the latter group are known before the Miocene, it is not clear what the ancestry would be like.

Although it must be confessed that the brief arguments for these "derivations" are not in all cases very convincing, yet the discussion brings out the fact of a general similarity in fundamental structure throughout the order, so that, although there is as yet no unanimity of opinion as to the precise relationships of many known genera, it does seem possible to perceive how some of the special peculiarities of various groups may have been evolved. An important section of the paper is contained in the second part—Notes,—which, besides brief discussion of controversial points, contains references to the more important literature on the order.

The translation has been done with care, even to the reproduction of the author's emendations (*e.g.*, *Rhachionectes* for *Rhachianectes*, *Xiphius* for *Ziphius*, etc.), and with a view to giving "the author's ideas as clearly and exactly as possible rather than to make smooth English sentences." Much credit is due the translator for making this important summary now readily available in English.

—*Glover M. Allen.*

Osgood, Wilfred H. A Monographic Study of the American Marsupial, Cænolestes. Field Mus. Nat. Hist., Zoöl. Ser., vol. 14, no. 1, pp. 1–162; 22 plates. May, 1921.

The curious South American marsupial *Cænolestes* has been the subject of much discussion, and has been placed in three different suborders by various workers who have dealt with its systematic position. Osgoods' extended descriptive account of its anatomy, and the conclusions based on his researches are, therefore, of great interest to all technical mammalogists.

The introductory sections include the general history of *Cænolestes* from its discovery in 1860 up to the present time, what little is known of its habits, and an account of its external characters. Following this, in the main body of the work, are detailed descriptions of the myology (pp. 22–61), urogenital system, alimentary canal, glands, respiratory and circulatory systems (pp. 61–77), skeleton and teeth (pp. 77–128). Additional chapters of special interest are: The origin or diprotodonty, relationships of *Wynyardia*, relationships of *Myrmecoboides*, phylogeny and taxonomy, and dispersal of marsupials. These all show the intensive study, clear reasoning, and fair presentation of the subject that we have learned to expect in the author's publications. A diagram of the phylogenetic

and taxonomic relationships of the principal groups of marsupials accompanies the discussion.

The essential points in Doctor Osgood's carefully prepared summary of his studies of *Cænolestes*, briefly stated, are: 1. *Cænolestes* is a surviving member of an ancient group and retains many primitive characters. 2. It has numerous resemblances to modern peramelids. 3. It has few non-marsupial characters and no great degree of specialization. 4. It has no especial affinity to the American Didelphiidæ. 5. The ancestor of the cænolestids was probably a northern form which had already separated from the generalized polyprotodont stock. 6. The North American ancestor of the cænolestids possibly extended throughout Holarctica and therefore may also have given rise to the Australian diprotodonts. 7. The phylogenetic and morphological relations of *Cænolestes* are best expressed by classifying it in the suborder Diprotodontia, family Palæothentidæ, subfamily Cænolestinæ.

The text closes with six pages on the brain of *Cænolestes obscurus*, by Dr. C. Judson Herrick, professor of neurology, University of Chicago. The figures in the plates are well executed (the line drawings of muscles and soft parts are credited to R. E. Snodgrass, a sufficient guarantee of accuracy), and each plate is faced by a lettered reference page so that, in using the work, it is unnecessary to search constantly for a special "explanation of plates." There is, unfortunately, no index.

—*N. Hollister.*

King, Helen Dean. A Comparative Study of the Birth Mortality in the Albino Rat and in Man. Anat. Record, vol. 20, pp. 321–354. March 20, 1921.

A summary of the results of Doctor King's valuable experiments shows that during a period of 5 years in a total of 31,670 newborn albino rats 415, or 1.3 per cent, were stillborn. Under normal environmental conditions not more than 2 per cent of rat fetuses are dead at birth. Normal birth mortality in man is about 4 per cent. There are no data regarding percentage of stillbirths in other mammals. The normal sex ratio in newborn albino rats, including stillborn, is about 107 males to 100 females. The average in man is about 108 males to 100 females. Doctor King found an excess of males among stillborn in rats, the ratio being 129.3 males to 100 females. Sex ratio among stillborn children is about 130 to 140 boys to 100 girls. In the rat the percentage of stillbirths seems to vary somewhat with the seasons, being greatest in the autumn and least in the spring. It appears that malnutrition is directly responsible for most of the stillbirths.

—*Hartley H. T. Jackson.*

Johnston, T. B. The Ileo-caecal Region of Callicebus personatus, with some Observations on the Morphology of the Mammalian Caecum. Journ. Anat. (London), vol. 54, part I, pp. 66–78. 1919.

These studies are based chiefly on the Brazilian mammals *Callicebus personatus*, *Dasypus sexcinctus*, *Tatusia novemcincta*, and *Cyclothurus didactylus*. In *Callicebus* the caecum is an actively functioning part of the alimentary canal. The paired lateral caeca of *Dasypus sextinctus* and *D. villosus* are regarded as the

extremities of a bifid caecum, but those of *Cyclothurus* are new formations which do not correspond to the morphological caecum. The primitive mammalian caecum was an asymmetrical structure derived from the anti-mesenteric border of the colon.

—*A. H. Schultz.*

Nomai, J. Das Stimmorgan der Primaten. Anatom. Hefte, vol. 59, 1. Abt., pp. 257–292. 1920.

This study shows the generally high development of the larynx in primates. The laryngeal cartilages in monkeys and apes resemble closely those structures in man, but the vocal lips are quite different. The arytaenoid cartilages are slender and delicate when compared with those of lemurs and all other mammals.

—*A. H. Schultz.*

Doflein, F. Die Fortpflanzung, die Schwangerschaft und das Gebären der Säugetiere. Jena, 70 pp. 1920.

A richly illustrated good review of our knowledge of fertilization, implantation, placentation, pregnancy, and birth in mammals. The paper contains no actually new facts but constitutes a new presentation and welcome collection of widely scattered data.

—*A. H. Schultz.*

Asomi, Goichi. Observations on the follicular atresia in the rabbit ovary. Anat. Rec., vol. 18, no. 4, pp. 323–343. May 20 (June), 1920.

Baldwin, Francis Marsh. Notes on the branches of the aorta (arcus aortae) and the subclavian artery of the rabbit. Anat. Rec., vol. 19, pp. 173–183, 11 figs. July 20, 1920.

Black, Davidson. Studies on endocranial anatomy. II. On the endocranial anatomy of Oreodon (Merycoidodon). Journ. Comp. Neurology, vol. 32, pp. 271–327, 48 figs. December, 1920. (Concludes that *Oreodon* was a primitive artiodactyl, presenting a curious blending of suilline and ruminant characters; any edentate resemblances are of a superficial nature.)

Burrell, Harry. Preliminary note on the breeding of *Ornithorhynchus* in 1920. Australian Zool., vol. 2, pt. 2, pp. 20–23, 2 plates. April 11, 1921. (Of the 11 nests studied, 6 contained eggs and 5 contained young; the number of eggs ranges from 1 to 3.)

Cadwalder, Williams B. Forty-ninth annual report of the Board of Directors of the Zoological Society of Philadelphia. Pp. 1–50. 1921. (Includes report of Dr. Herbert Fox, pathologist.)

Cooper, A. R. A case of the inferior vena cava uniting with the azygos vein in the dog. Anat. Rec., vol. 17, pp. 299–306, 2 figs. January 20 (February), 1920.

Dreyer, W. Vejleder i Zoologisk Have. Pp. 1–72, many figs. Kjöbenhavn, 1921. (Guide to the Copenhagen zoological gardens.)

Gillespie, T. H. Annual report of the Zoological Society of Scotland for the year ending 31st March 1921. Pp. 1–20, 8 plates. 1921.

Haagner, Alwin. South African mammals. A short manual for the use of field naturalists, sportsmen and travellers. Pp. i–xx; 1–248; many illustrations. London; H. F. & G. Witherby. 1920.

——— National zoological gardens of South Africa, Pretoria. Report for the years 1919–1920. 23 pp. 1921.

Hanson, Frank Blair. The development of the sternum in Sus scrofa. Anat. Rec., vol. 17, pp. 1–23, 19 figs. September 20, 1919.

——— The development of the shoulder-girdle of Sus scrofa. Anat. Rec., vol. 18, no. 1, pp. 1–21. February 20 (March), 1920.

——— The problem of the coracoid. Anat. Rec., vol. 19, pp. 327–345, 7 figs. November 20, 1920.

Harkin, J. B. Report of the commissioner of Dominion parks for the year ending March 31, 1920. Pp. 1–53, numerous half-tones. Ottawa, 1921. (Reports a general increase in game mammals in all reservations.)

Herrick, C. Judson. The brain of Cænolestes obscurus. Field Mus. Nat. Hist., Zoöl. Ser., vol. 14, no. 1., pp. 157–162; pls. 21–22. May, 1921.

Hinton, Martin A. C. A new bank-vole from Esthonia. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 128–129. July, 1921. (Describes *Evotomys glareolus reinwaldti*, subsp. nov.)

——— The klipspringers of Rhodesia, Angola, and northern Nigeria. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 129–133. July, 1921. (New: *Oreotragus oreotragus centralis*, Rhodesia; *O. o. tyleri*, Angola; and *O. o. hyatti*, Nigeria.)

Hollister, N. A new name for the West African pygmy squirrel. Proc. Biol. Soc. Washington, vol. 34, p. 135. June 30, 1921. (*Myosciurus minutulus* for *Sciurus minutus* Du Chaillu, preoccupied.)

Hornaday, William T. The fur trade and wild animals. Wisconsin Conservationist, vol. 3, no. 2, pp. 5–6. May, 1921. (Considers fur-bearing animals in danger of extermination, but believes that there is yet hope of saving a remnant of them.)

Huntington, George S. The morphology of the pulmonary artery in the Mammalia. Anat. Rec., vol. 17, pp. 165–201, 7 figs (5 colored). December 20, 1919 (January, 1920).

Huntington, George S., and Charles F. W. McClure. The development of the veins in the domestic cat (*Felis domestica*) with especial reference, (1) to the share taken by the supracardinal veins in the development of the postcava and azygos veins and (2) to the interpretation of the variant conditions of the postcava and its tributaries, as found in the adult. Anat. Rec., vol. 20, pp. 1–30, 12 figs. in colors. December 20, 1920.

Kershaw, P. S. On the collection of South African mammals in the Durban Museum. Ann. Durban Mus., vol. 3, pt. 1, pp. 27–38. January 31, 1921. (New: *Pachyura chriseos* and *Sylvisorex gemmeus sheppardi.*)

Kittelson, John A. Effects of inanition and refeeding upon the growth of the kidney of the albino rat. Anat. Rec., vol. 17, pp. 281–295. January 20 (February), 1920.

Kloss, C. Boden. Two new *Leggada* mice from Siam. Journ. Nat. Hist. Soc. Siam, vol. 4, pp. 59–63. March, 1921. (Key to Indochinese genera of *Mus*-like rodents. New species and subspecies: *Leggada pahari gairdneri* and *L. rahengis*, both from Me Taw, western Siam.)

Kloss, C. Boden. On *Rattus blythi* Kloss (*Mus cinnamomeus* Blyth). With remarks on allied forms. Journ. Nat. Hist. Soc. Siam, vol. 4, pp. 65–69. March, 1921.

——— A new giant squirrel from Pulo Condore. Journ. Nat. Hist. Soc. Siam, vol. 4, pp. 71–72. March, 1921. (Describes *Ratufa melanopepla condorensis*.)

——— The Pulo Condore group and its mammals. Journ. Nat. Hist. Soc. Siam, vol. 4, pp. 73–83. March, 1921. (List of 9 species of mammals, with critical notes.)

——— On a small collection of mammals from Cambodia. Journ. Nat. Hist. Soc. Siam, vol. 4, pp. 99–102. March, 1921. (New: *Tamiops macclellandi dolphoides*, from southwestern Cambodia.)

——— Two new races of Sciurus finlaysoni. Journ. Nat. Hist. Soc. Siam, vol. 4, pp. 103–104. March, 1921. (Describes *S. f. prachin*, Krabin, Central Siam, and *S. f. rajasima*, Lat Bua Kao, Eastern Siam.)

——— A habitat of Schomburgk's deer (*Cervus schomburgki*). Journ. Nat. Hist. Soc. Siam, vol. 4, p. 105. March, 1921.

——— Malaysian bearded pigs. Journ. Straits Branch, Royal Asiatic Soc., no. 83, pp. 147–150. April, 1921. (Remarks on *Sus barbatus*, *Sus oi*, and other wild pigs of Borneo and Sumatra.)

——— A new squirrel from North Sarawak. Journ. Straits Branch, Royal Asiatic Soc., no. 83, pp. 151–152. April, 1921. (*Sciurus adamsi*, sp. nov., Long Mujan, North Sarawak, Borneo.)

Kolmer, W. Über die Tastorgane von *Elephas indicus*. Anat. Anz., vol. 54, no. 5, pp. 73–77. May 22, 1921.

Kraatz, Walter C. A preliminary general survey of the macrofauna of Mirror Lake on the Ohio State University campus. Ohio Journ. Sci., vol. 21, no. 5, pp. 137–184. March, 1921. (Mentions occurrence of muskrat and Norway rat.)

Kuntz, Albert. The inervation of the gonads in the dog. Anat. Rec., vol. 17, pp. 203–219, 4 figs. December 20, 1919 (January, 1920).

——— Experimental degeneration in the testis of the dog. Anat. Rec., vol. 17, pp. 221–234, 4 figs. December 20, 1919 (January, 1920).

Lönnberg, Einar. A second contribution to the mammalogy of Ecuador with some remarks on Cænolestes. Arkiv f. Zool., vol. 14, no. 4, pp. 1–104, 1 plate and 8 text figs. 1921. (New: *Nasua gualeae, Dactylomys dactylinus modestus, Myoprocta exilis parva, Coelogenys paca guanta, Dinomys branickii occidentalis, Dicotyles pecari aequatoris, Lonchoglossa wiedi aequatoris, Nasua nasua söderströmii, N. henseli*, and *N. h. cinerascens*.)

Matthew, W. D. The Cannonball Lance formation. Science, n. s., vol. 54, pp. 27–29. July 8, 1921.

——— Notes on the scientific museums of Europe. Nat. Hist., vol. 21, pp. 185–190. March–April, 1921.

McAtee, W. L. The selection of family names in zoology. Journ. Washington Acad. Sci., vol. 11, pp. 230–235. May 19, 1921. (Argues for family names based on the oldest available generic name.)

Miller, Gerrit S., Jr., and N. Hollister. Twenty new mammals collected by H. C. Raven in Celebes. Proc. Biol. Soc. Washington, vol. 34, pp. 93–104. June 30, 1921. (New genera and species: *Melasmothrix naso* and

Eropeplus canus. New species and subspecies of *Lenomys, Rattus, Sciurus, Harpyionycteris, Pteropus, Cheiromeles, Crocidura,* and *Tarsius.*)

Mitchell, P. Chalmers. Official guide to the gardens of the Zoological Society of London. Nineteenth edition. 112 pp., 52 illust. 1921.

Nelson, Edward W. Lower California and its natural resources. Mem. Nat. Acad. Sci., vol. 16, no. 1, pp. 1–194; 34 plates and folding map. 1921. (Contains many references to mammals; maps and definitions of life zones.)

Osborn, Henry Fairfield. First appearance of the true mastodon in America. Amer. Mus. Novit., no. 10, pp. 1–6; figs. 1–2. June 15, 1921. (Describes *Mastodon matthewi,* Sioux County, Nebraska; and *M. merriami,* Humboldt County, Nevada.)

——— The first appearance of the true mastodon in America. Science, n. s., vol. 54, p. 108. August 5, 1921.

Pires de Lima, J. A. Anatomy of a fetus of a cyclopean goat. Anat. Rec., vol. 19, pp. 73–81, 6 figs. July 20, 1920.

Rothschild, Lord. On two new races of *Oryx.* Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 209–210. August, 1921. (Describes *Oryx gazella blainei* from Angola, and *O. g. subcallotis* from southern British East Africa.)

Rutledge, Archibald. Plantation game trails. 300 pp., 12 pls. The Riverside Press, Cambridge, Mass. February, 1921. (Largely devoted to accounts of hunting the white-tailed deer near the mouth of the Santee River, South Carolina. Contains notes on habits of the deer, otter, and fox squirrel.)

Scott, H. H., and Clive E. Lord. Nototheria and allied animals,—a rejoinder. Papers of the Royal Soc. Tasmania, pp. 5, pls. 3, issued separately, May 14, 1921.

Shiras, George, 3rd. The wild life of Lake Superior, past and present. Nat. Geog. Mag. vol. 40, no. 2, pp. 114–204; 76 illustrations. August, 1921. (Includes notes on habits of deer, moose, wolves, beavers, and muskrats.)

Siperstein, David M. The effects of acute and chronic inanition upon the development and structure of the testis in the albino rat. Anat. Rec., vol. 20, pp. 355–391, 14 figs. March 20, 1921.

Souchon, Edmond. A new permanent solution for the preservation of anatomic preparations, the Souchon solution of calcium chloride. Anat. Rec., vol. 18, no. 4, p. 361. May 20 (June), 1920.

Standley, Paul C. Albinism in the black bear. Science, n. s., vol. 54, p. 74. July 22, 1921.

Taylor, Walter P. Thomomys douglasii shawi, a new subspecies of pocket gopher from Mount Rainier, Washington. Proc. Biol. Soc. Washington, vol. 34, pp. 121–122. June 30, 1921.

Thomas, Oldfield. Three new species of Marmosa, with a note on *Didelphys waterhousei,* Tomes. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, pp. 519–523. June, 1921. (New: *Marmosa bruchi,* San Luis, Argentina; *M. verax,* Mision, Paraguay; and *M. mimetra,* Santo Domingo, Ecuador.)

——— The tuco-tuco of San Juan, Argentina. Ann and Mag. Nat. Hist., ser. 9, vol. 7, pp. 523–524. June, 1921. (*Ctenomys coludo johannis,* subsp. nov.)

——— The Arctonyx of Annam. Ann. and Mag. Nat. Hist., ser. 9, vol. 7, p. 524. June, 1921. (Describes *Arctonyx annæus* from Nha-trang, Annam.)

Thomas, Oldfield. Choiropotamus versus Koiropotamus. Proc. Biol. Soc. Washington, vol. 34, p. 135. June 30, 1921. (Maintains that *Choiropotamus* is the tenable name of the river hogs.)

——— The geographical races of *Herpestes brachyurus*, Gray. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 134–136. July, 1921. (New: *Herpestes brachyurus sumatrius*, Sumatra; *H. b. rajah*, lowlands of Sarawak, Borneo; *H. b. dyacorum*, mountains of Sarawak, Borneo.)

——— A new genus of opossum from southern Patagonia. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 136–139. July, 1921. (New genus and species: *Notodelphys halli*, from Cape Tres Puntas, Patagonia.)

——— A new bat of the genus *Promops* from Peru. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, p. 139. July, 1921. (Describes *Promops davisoni* from Department of Lima, Peru.)

——— On spiny rats of the *Proechimys* group from south-eastern Brazil. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 140–143. July, 1921. (New subgenus: *Trinomys*; new subspecies: *Proechimys albispinis sertonius*, Bahia, Brazil.)

——— The "huron" of the Argentine. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 212–213. August, 1921. (New: *Grisonella huronax* from Mar del Plata, Argentina.)

——— On mammals from the province of San Juan, western Argentina. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 214–221. August, 1921. (Describes new forms of *Grisonella, Abrocoma, Octomys, Ctenomys,* and *Lagidium*.)

——— Two new Argentine forms of skunk. Ann. and Mag. Nat. Hist., ser. 9, vol. 8, pp. 221–222. August, 1921. (New: *Conepatus suffocans pampanus* and *C. s. mendosus*.)

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